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14. ABSTRACT The program on Climate Change, State Stability, and Political Risk in Africa (also referred to as the Climate Change and African Political Stability program, or CCAPS) conducted research in three core areas. It investigated where and how climate change poses threats to stability in Africa, identified strategies to support accountable and effective governance in Africa, and evaluated the effectiveness of international aid to help African societies adapt to climate change.					
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Report Title

Final Report: Climate Change, State Stability, and Political Risk in Africa

ABSTRACT

The program on Climate Change, State Stability, and Political Risk in Africa (also referred to as the Climate Change and African Political Stability program, or CCAPS) conducted research in three core areas. It investigated where and how climate change poses threats to stability in Africa, identified strategies to support accountable and effective governance in Africa, and evaluated the effectiveness of international aid to help African societies adapt to climate change.

In its final year, the Armed Conflict Location and Event Dataset (ACLED) released version 6.0 that covers all African political violence from 1997-2015 and it continued to release real-time 2016 data weekly for 30 high-risk states and publish monthly conflict trends reports. The Social Conflict Analysis Database (SCAD) released version 3.2 that covers social conflict events in Africa, Latin America, and the Caribbean from 1990-2015. The CCAPS research team on constitutional design and conflict management held a symposium to discuss their recently published book, and other CCAPS research teams published their final briefs and articles on climate change vulnerability, climate-conflict links, urban resilience, government response, and climate change adaptation aid.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

<u>Received</u>	<u>Paper</u>
08/11/2014 25.00	Kerry Cook, Edward Vizio. Projected Changes in East African Rainy Seasons, Journal of Climate, (02 2013): 5931. doi:
08/13/2014 50.00	Josh Busby, Kerry Cook, Edward Vizio, Todd Smith, Mesfin Bekalo. Identifying Hot Spots of Security Vulnerability Associated with Climate Change in Africa, Climate Change, (06 2014): 717. doi:
08/15/2015 08.00	C. S. Hendrix, S. Haggard. Global food prices, regime type, and urban unrest in the developing world, Journal of Peace Research, (02 2015): 0. doi: 10.1177/0022343314561599
08/15/2015 09.00	T. G. Smith. Feeding unrest: Disentangling the causal relationship between food price shocks and sociopolitical conflict in urban Africa, Journal of Peace Research, (10 2014): 0. doi: 10.1177/0022343314543722
08/15/2015 07.00	Colleen Devlin, Cullen S. Hendrix . Trends and Triggers Redux: Climate Change, Rainfall, and Interstate Conflict, Political Geography, (08 2014): 27. doi:
08/17/2015 10.00	Joshua W. Busby, Todd G. Smith, Nisha Krishnan. Climate Security Vulnerability in Africa Mapping 3.0, Political Geography, (11 2014): 51. doi:
08/27/2014 63.00	Caitriona Dowd, Clionadh Raleigh. Country Report: DR Congo, CCAPS Research Brief Series, (12 2013): 0. doi:
08/27/2014 64.00	Léa Macias. Complex Emergencies, CCAPS Research Brief Series, (08 2013): 0. doi:
08/27/2015 17.00	Cullen S. Hendrix, Idean Salehyan. No News Is Good News: Mark and Recapture for Event Data When Reporting Probabilities Are Less Than One, International Interactions, (04 2015): 0. doi: 10.1080/03050629.2015.982117
08/27/2015 18.00	I. Salehyan. Best practices in the collection of conflict data, Journal of Peace Research, (01 2015): 0. doi: 10.1177/0022343314551563
08/28/2014 69.00	Aleksandra Egorova, Cullen Hendrix. Can Natural Disasters Precipitate Peace?, CCAPS Research Brief Series, (08 2014): 1. doi:
08/28/2014 70.00	Clionadh Raleigh, Caitriona Dowd, Matt Batten-Carew, Gabrielle Daoust, Daniel Wigmore-Shepherd. Real-time Analysis of African Political Violence: Conflict Trends Report No.29, Conflict Trends, (08 2014): 0. doi:
08/28/2014 72.00	Clionadh Raleigh, Andrew Linke, John O'Laughlin. Extreme Temperatures and Violence, Nature Climate Change 4, (02 2014): 76. doi:
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- 08/29/2013 79.00 Kerry H. Cook, Julien Cr  tat, Naresh Neupane, Edward K. Vizzy. Projections of a Wetter Sahel in the Twenty-First Century from Global and Regional Models, Journal of Climate, (07 2013): 0. doi: 10.1175/JCLI-D-12-00533.1
- 08/29/2013 78.00 Kerry H. Cook, Edward K. Vizzy. Projected Changes in East African Rainy Seasons, Journal of Climate, (08 2013): 0. doi: 10.1175/JCLI-D-12-00455.1
- 08/29/2013 77.00 Joshua W. Busby, Jay Gullede, Todd G. Smith, Kaiba White. Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa, Air and Space PowerJournal-Africa and Francophonie, (09 2012): 4. doi:
- 08/30/2011 1.00 C. Raleigh, A. Linke, H. Hegre, J. Karlsen. Introducing ACLED: An Armed Conflict Location and Event Dataset: Special Data Feature, Journal of Peace Research, (09 2010): 0. doi: 10.1177/0022343310378914
- 08/30/2011 2.00 Clionadh Raleigh. Seeing the Forest for the Trees: Does Physical Geography Affect a State's Conflict Risk?, INTERNATIONAL Interactions, (11 2010): 384. doi: 10.1080/03050629.2010.524524
- 08/30/2011 3.00 Catherine Weaver. Comment on Michaelowa and Michaelowa (2011): Climate business for poverty reduction: The role of the World Bank, Review of International Organizations, (04 2011): 0. doi: 10.1007/s11558-011-9114-9
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- 09/17/2014 74.00 Catherine Weaver , Stephen Davenport , Justin Baker, Michael Findley , Christian Peratsakis, Josh Powell. Malwai Case Study, CCAPS Research Brief Series, (03 2014): 0. doi:
- 09/17/2014 75.00 Caitriona Dowd , Clionadh Raleigh. ACLED Country Report Kenya, ACLED Country Report, (03 2014): 0. doi:
- 10/09/2014 78.00 Emily Cunningham. ACLED Country Report DR Congo December 2013, ACLED Country Report, (12 2013): 0. doi:

TOTAL: 24

(b) Papers published in non-peer-reviewed journals (N/A for none)

<u>Received</u>	<u>Paper</u>
03/29/2012 39.00	Emily Joiner, Derell Kennedo, Jesse Sampson. Vulnerability to Climate Change in West Africa: Adaptive Capacity in the Regional Context, Student Working Paper No. 4, Working Paper Series, (02 2012): 0. doi:
03/29/2012 40.00	Catherine Weaver, Christian Peratsakis. Can Better Tracking of Adaptation Aid Reduce Climate Change Vulnerabilities on the Ground? Research Brief No. 2, CCAPS Research Brief Series, (11 2011): 0. doi:
08/11/2014 24.00	Kuperman, Alan. Constitutional Design and Conflict Management, Peace economics, Peace Science and Public Policy, (10 2013): 1. doi:
08/11/2014 38.00	Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence:Conflict Trends No.23, ACLED Conflict Trends (No. 23), (02 2014): 1. doi:
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08/11/2014 36.00	Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence:Conflict Trends No.21, ACLED Conflict Trends (No. 21), (12 2013): 1. doi:
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08/11/2014 32.00	Caitriona Dowd, Clionadh Raleigh. Real-time analysis of African Political Violence:Conflict Trends No.18, ACLED Conflict Trends (No. 3), (09 2013): 1. doi:
08/11/2014 29.00	Brittany Franck, Colleen Devlin, Cullen Hendrix. Trends and Triggers: Climate Change and Interstate Conflict, CCAPS Research Brief Series, (12 2013): 1. doi:
08/11/2014 28.00	Alan Kuperman. Constitutional Reform for Conflict Management, CCAPS Course Module, (04 2014): 1. doi:
08/11/2014 26.00	Catherine Weaver, Justin Baker, Sarah McDuff. Tracking Climate Aid in Africa: The case of Malawi, CCAPS Research Brief Series, (09 2013): 1. doi:
08/12/2015 79.00	Justin Baker, Emmy Griffin, Krista Rasmussen, Catherine Weaver. Tracking Climate Aid in Africa: The Case of the World Bank, CCAPS Research Brief Series, (04 2015): 1. doi:
08/12/2015 82.00	Emmy Griffin. Smallholder Vulnerability in African Agriculture, CCAPS Research Brief Series, (12 2014): 1. doi:
08/12/2015 81.00	Aleksandra Egorova, Cullen S. Hendrix. Can Natural Disasters Precipitate Peace?, CCAPS Research Brief Series, (08 2014): 1. doi:
08/12/2015 80.00	Andrea Carboni. The Cycle of Conflict in Post-Revolutionary Tunisia, 2011-2014, ACLED Working Paper , (06 2015): 1. doi:

- 08/13/2014 39.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, ACLED Conflict Trends (No. 24), (03 2014): 1. doi:
- 08/13/2014 49.00 Robert Wilson, Todd Smith. Urban Resilience to Climate Change Challenges in Africa, CCAPS Working Paper Series, (05 2014): 1. doi:
- 08/13/2014 47.00 Idean Salehyan, Cullen Hendrix. Explaining Government Repression in Africa, CCAPS Research Brief Series, (11 2013): 1. doi:
- 08/13/2014 46.00 Abigail Ofstedahl, Elena Rodriguez, Justin Baker, Catherine Weaver. Tracking Aid for Food Security: Methodology and Pilot Case Study in Malawi, CCAPS Research Brief Series, (08 2013): 1. doi:
- 08/13/2014 45.00 Ashley Moran, Dominique Thuot. Bridging the Policy Gap: Mapping Climate Change and Security for Impact in Africa, CCAPS Research Brief Series, (12 2013): 1. doi:
- 08/13/2014 44.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence: Conflict Trends Report No.28, ACLED Conflict Trends (No. 28), (07 2014): 1. doi:
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- 08/13/2014 41.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence: Conflict Trends Report No.26, ACLED Conflict Trends (No. 26), (05 2014): 1. doi:
- 08/13/2014 40.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence: Conflict Trends Report No.25, ACLED Conflict Trends (No. 25), (04 2014): 1. doi:
- 08/13/2015 89.00 Clionadh Raleigh, Caitriona Dowd, James Moody . Real-Time Analysis of African Political Violence, May 2015, Conflict Trends, (05 2015): 1. doi:
- 08/13/2015 05.00 Catherine Weaver. Climate Change and Development, CCAPS Course Module, (11 2014): 1. doi:
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- 08/13/2015 03.00 Robert H. Wilson, Todd G. Smith. Climate Change Resilience in Urban Africa, Part I: The Policy Challenge, CCAPS Research Brief Series, (02 2015): 1. doi:
- 08/13/2015 02.00 Daniel Wigmore-Shepherd . Reporting Sources, ACLED Working Paper , (04 2015): 1. doi:
- 08/13/2015 01.00 Catherine Weaver. Climate Change and Development, CCAPS Research Brief Series, (01 2015): 1. doi:
- 08/13/2015 00.00 Idean Salehyan , Brandon Stewart. Understanding the Targets of Social Conflict, CCAPS Research Brief Series, (12 2014): 1. doi:
- 08/13/2015 99.00 Cherie Saulter. Resilience Strategies in Fragile States, CCAPS Research Brief Series, (12 2014): 1. doi:
- 08/13/2015 98.00 Lindsay Read. Assessing Urban and Rural Food Security, CCAPS Research Brief Series, (12 2014): 1. doi:

08/13/2015 97.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, August 2014, ACLED Conflict Trends, (08 2014): 1. doi:

08/13/2015 96.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, September 2014, ACLED Conflict Trends , (09 2014): 1. doi:

08/13/2015 95.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, October 2014, ACLED Conflict Trends , (10 2014): 1. doi:

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08/13/2015 85.00 James Moody. Collective Action in North Africa, ACLED Working Paper , (04 2015): 1. doi:

08/13/2015 84.00 Jesse Libra. Outgrower Systems for Inclusive Agricultural Growth, CCAPS Research Brief Series, (12 2014): 1. doi:

08/13/2015 86.00 Ashley M. Moran, Yacob Mulugetta, Clionadh Raleigh. Climate Change and Security in Africa: Clear Risks, Nuanced Impacts, GMACCC Paper, (12 2014): 0. doi:

08/13/2015 83.00 Cullen Hendrix. Water Security in Niger and the Sahel, CCAPS Research Brief Series, (12 2014): 1. doi:

08/13/2015 88.00 Clionadh Raleigh, Caitriona Dowd, James Moody. Real-Time Analysis of African Political Violence, June 2015, Conflict Trends, (06 2015): 1. doi:

08/13/2015 87.00 Clionadh Raleigh, Caitriona Dowd, James Moody. Real-Time Analysis of African Political Violence, July 2015, ACLED Conflict Trends , (07 2015): 1. doi:

08/24/2015 11.00 Matt Batten Carew, Caitriona Dowd. ACLED Country Report: Mali, ACLED Country Report, (01 2015): 0. doi:

08/24/2015 15.00 Robert Wilson. Climate Change and Cities in Africa: Current Dilemmas and Future Challenges, CCAPS Course Module, (10 2014): 0. doi:

08/24/2015 14.00 Grace Duffy, Gabrielle Daoust. ACLED Country Report: Central African Republic, ACLED Country Report, (01 2015): 0. doi:

08/24/2015 13.00 Gabrielle Daoust. ACLED Country Report: Sudan and South Sudan, ACLED Country Report, (01 2015): 0. doi:

08/24/2015 12.00 Jennifer Bussell. Institutional Capacity and Natural Disasters, CCAPS Course Module, (09 2014): 0. doi:

- 08/29/2013 80.00 Christine Ackerson, Emily Adams, Jon Arnold, Sarah Fiorenza, Hoor Jangda, Amy Knop-Narbutis, Vera Magero, Dylan Malcomb, Gigi Mao, Nancy Peek, Pace Phillips,, Allison Ramirez, Valerie Schillaci, Jessica Tibbets, Kelly Usher, Kathryn Yeager. Climate Change and Development in Africa, CCAPS Student Working Paper Series, (03 2013): 1. doi:
- 08/29/2013 07.00 Daniel Strandow, Michael Findley, Josiah Marineau, Xuanxuan Wu. Mapping Territorial Control in Violent Armed Conflict, CCAPS Research Brief Series, (04 2013): 1. doi:
- 08/29/2013 23.00 Clionadh Raleigh, Caitriona Dowd. Governance and Conflict in the Sahel's 'Ungoverned Space', Stability: International Journal of Security & Development, (07 2013): 1. doi:
- 08/29/2013 85.00 Jennifer Bussell. Institutional Capacity for Natural Disasters: Findings from Case Studies in Africa, CCAPS Research Brief Series, (03 2013): 1. doi:
- 08/29/2013 81.00 Emerta Asaminew Aragie. Climate Change, Growth, and Poverty in Ethiopia, CCAPS Working Paper Series, (06 2013): 1. doi:
- 08/29/2013 82.00 Joshua Busby. Climate Change and National Security, CCAPS Course Module, (02 2013): 1. doi:
- 08/29/2013 83.00 Joshua Busby, Todd G. Smith, Nisha Krishnan, Mesfin Bekalo. Advances in Mapping Climate Security Vulnerability in Africa, CCAPS Research Brief Series, (04 2013): 1. doi:
- 08/29/2013 84.00 Jennifer Bussell, Adam Colligan. Institutional Capacity for Natural Disasters: Methodology for Case Studies in Africa, CCAPS Research Brief Series, (03 2013): 1. doi:
- 08/29/2013 86.00 Caitriona Dowd. Tracking Islamist Militia and Rebel Groups, CCAPS Research Brief Series, (02 2013): 1. doi:
- 08/29/2013 87.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, ACLED Conflict Trends , (08 2012): 1. doi:
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- 08/29/2013 91.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, ACLED Conflict Trends , (12 2012): 1. doi:
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- 08/29/2013 93.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, February 2013, ACLED Conflict Trends , (02 2013): 1. doi:
- 08/29/2013 94.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, March 2013, ACLED Conflict Trends , (03 2013): 1. doi:
- 08/29/2013 95.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, April 2013, ACLED Conflict Trends , (04 2013): 1. doi:
- 08/29/2013 96.00 Caitriona Dowd, Clionadh Raleigh. Somalia, ACLED Country Report, (04 2013): 1. doi:

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- 08/29/2013 98.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, May 2013, ACLED Conflict Trends , (05 2013): 1. doi:
- 08/29/2013 99.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, June 2013, ACLED Conflict Trends , (06 2013): 1. doi:
- 08/29/2013 00.00 Caitriona Dowd, Clionadh Raleigh. Real-Time Analysis of African Political Violence, July 2013, ACLED Conflict Trends , (07 2013): 1. doi:
- 08/29/2013 01.00 Cullen S. Hendrix. Climate Change, Global Food Markets, and Urban Unrest, CCAPS Research Brief Series, (02 2013): 1. doi:
- 08/29/2013 03.00 Ignatius A. Madu. Spatial Vulnerability of Rural Nigeria to Climate Change: Implications for Internal Security, International Journal of Climate Change, (10 2012): 79. doi:
- 08/29/2013 02.00 Alan J. Kuperman. Constitutional Reform and Violent Conflict: Lessons from Africa, for Africa, CCAPS Research Brief Series, (07 2013): 1. doi:
- 08/29/2013 04.00 Clionadh Raleigh. Migration, Urbanization, and Political Power in Africa, CCAPS Research Brief Series, (07 2013): 1. doi:
- 08/29/2013 05.00 Idean Salehyan, Christopher Linebarger. Elections and Social Conflict in Africa, CCAPS Research Brief Series, (02 2013): 1. doi:
- 08/29/2013 06.00 Todd G. Smith. Food Price Spikes and Social Unrest in Africa, CCAPS Research Brief Series, (04 2013): 1. doi:
- 08/29/2013 08.00 Catherine Weaver, Justin Baker, Christian Peratsakis. Tracking Climate Adaptation Aid: Methodology, CCAPS Research Brief Series, (09 2012): 1. doi:
- 08/30/2011 8.00 Bonnie Doty, Erika Grajeda, Pace Phillips, Atul Shrestha. Vulnerability to Climate Change: An Assessment in East and Central Africa, Student Working Paper No. 2, CCAPS Student Working Paper Series, (08 2011): 0. doi:
- 08/30/2011 9.00 Cullen Hendrix, Idean Salehyan. The Brewing Storm: Climate Change, Rainfall and Social Conflict in Africa, Policy Brief No. 2, CCAPS Policy Brief Series, (02 2011): 0. doi:
- 08/30/2011 5.00 Joshua W. Busby, Kaiba White, Todd G. Smith. Mapping Climate Change and Security in North Africa, German Marshall Fund Working Paper Series, (10 2010): 0. doi:
- 08/30/2011 7.00 Sanjeet Deka, Christian Glakas, Marc Olivier. Assessing Climate Vulnerability in North Africa, Student Working Paper No. 3, CCAPS Student Working Paper Series, (08 2011): 0. doi:
- 08/30/2011 11.00 J. Timmons Roberts, Martin Stadelmann. A Collective Commitment? Nailing down Climate Finance at Cancun and Durban, Outreach, (01 2011): 10. doi:
- 08/30/2011 12.00 Idean Salehyan, Cullen Hendrix. Science and the International Politics of Climate Change, The Whitehead Journal of Diplomacy and International Relations, (05 2011): 7. doi:
- 08/30/2011 13.00 Martin Stadelmann, J. Timmons Roberts, Axel Michaelowa. Keeping a Big Promise: Options for Baselines to Assess 'New and Additional' Climate Finance, CiS Working Paper, (11 2010): 0. doi:
- 08/31/2011 14.00 Christian Peratsakis, Catherine Weaver. International Development Assistance for Climate Change Adaptation in Africa: The Aid Scramble, Policy Brief No. 1, CCAPS Policy Brief Series, (09 2010): 0. doi:

08/31/2011 19.00 Todd G. Smith, Kaiba L. White, Shawn M. Strange, Joshua W. Busby. Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa? Working Paper No. 1, CCAPS Working Paper Series, (08 2010): 0. doi:

08/31/2011 20.00 Joshua W. Busby, Todd G. Smith, Kaiba L. White. Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa? Policy Brief No. 3, CCAPS Policy Brief Series, (06 2011): 0. doi:

08/31/2011 21.00 Alan J. Kuperman. Can Political Institutions Avert Conflict from Climate Change? , CCAPS Research Brief Series, (08 2011): 0. doi:

08/31/2011 23.00 Sachin D. Shah, Sarah J. Williams, Shu Yang. Vulnerability to Climate Change: Water Resource Stress and Food Insecurity in Southern Africa, Student Working Paper No. 1, CCAPS Student Working Paper Series, (08 2011): 0. doi:

TOTAL: 95

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received

Paper

06/18/2012 51.00 Todd G. Smith, Joshua W. Busby. Understanding the Climate Security Challenge: Advice for African Parliamentarians, Interparliamentary Dialogue on Climate Change in Relation to Peace and Security in Africa . 05-MAR-12, . : ,

08/29/2013 09.00 Ashley Moran (editor), Dominique Thuot (editor). Evolving Dynamics of Security in Africa: Assessing Diplomacy, Development, and Defense Responses, Evolving Dynamics of Security in Africa. 24-APR-12, . : ,

TOTAL: 2

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received

Paper

08/31/2011 37.00 Joshua Busby, Todd G. Smith, Kaiba White. Mapping Climate Change and Security in Africa, Proceedings of the 91st American Meteorological Society Annual Meeting. 23-JAN-11, . : ,

08/31/2011 32.00 Kerry H. Cook. Toward Confident and Useful Climate Change Projections: West Africa and the Sahel, 91st American Meteorological Society Annual Meeting. 23-JAN-11, . : ,

TOTAL: 2

(d) Manuscripts

<u>Received</u>	<u>Paper</u>
03/30/2012 41.00	Clionadh Raleigh, Dominic Kniveton. Come rain or shine: An analysis of conflict and climate variability in East Africa, Journal of Peace Research (01 2012)
03/30/2012 45.00	Kerry H. Cook, Edward K. Vizy. Impact of climate change on mid-twenty-first century growing seasons in Africa, Climate Dynamics (02 2012)
03/30/2012 44.00	Joshua W Busby, Kaiba L White, Todd G Smith. Climate Security and East Africa: A GIS-Based Analysis of Vulnerability, Political Geography (10 2011)
03/30/2012 43.00	Edward K. Vizy, Kerry H. Cook. Mid-21st century changes in extreme events over Northern and Tropical Africa, Journal of Climate (11 2011)
03/30/2012 42.00	Cullen S Hendrix, Idean Salehyan. Climate change, rainfall, and social conflict in Africa, Journal of Peace Research (01 2012)
06/18/2012 47.00	Idean Salehyan, Cullen S. Hendrix, Jesse Hamner, Christina Case, Christopher Linebarger, Emily Stull, Jennifer Williams. Social Conflict in Africa: A New Database, INTERNATIONAL Interactions (03 2012)
06/18/2012 50.00	Ignatius A. Madu. Spatial Vulnerability of Rural Households to Climate Change in Nigeria: Implications for Internal Security, CCAPS Working Paper Series (05 2012)
06/18/2012 49.00	Jared Berenter, Joshua Busby. "Ground Truthing" Vulnerability in Africa, CCAPS Research Brief Series (05 2012)
06/18/2012 48.00	Cullen Hendrix, Idean Salehyan. Climate Shocks and Political Violence: Beyond Scarcity, Beyond Africa, CCAPS Research Brief Series (04 2012)
07/12/2012 59.00	Cullen S. Hendrix. A Population-Centric View of Social, Political, and Economic Indicators of a Fragile State, Strategic Multi-Layer Assessment Program White Paper, Department of Defense (06 2012)
07/12/2012 60.00	Joshua Busby. The Sources of Climate Insecurity: Mapping Vulnerability in Africa, International Security (05 2012)
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07/12/2012 54.00	Clionadh Raleigh. The Search for Safety: The Effects of Conflict, Poverty and Ecological Influences on Migration in the Developing World, Global Environmental Change (04 2011)
07/12/2012 55.00	Chris Linebarger, Idean Salehyan. Elections and Social Conflict in Africa, 1990-2009, Comparative Political Studies (04 2012)

- 07/26/2012 62.00 Joshua Busby, Kerry Cook, Edward Vizi, Todd Smith, Kaiba White. Identifying Hot Spots of Security Vulnerability Associated with Climate Change in Africa, Proceedings of the National Academy of Sciences (07 2012)
- 07/26/2012 61.00 Cullen S. Hendrix. A Population Centric View of Social, Political and Economic Indicators of a 'Fragile State', Strategic Multi-Layer Assessment (SMA) White Volume (07 2012)
- 08/11/2014 27.00 Jennifer Bussell. Institutional Capacity for Natural Disasters:Case Studies in Africa, CCAPS Student Working Paper Series (05 2014)
- 08/13/2014 52.00 Colleen Devlin, Cullen Hendrix. 2014 Trends and Triggers Redux:Climate Change, Rainfall, and Interstate Conflict, Political Geography (12 2014)
- 08/13/2014 58.00 Cullen S. Hendrix, Idean Salehyan. Climate Shocks and Political Violence, Global Environmental Change (12 2014)
- 08/13/2014 56.00 Todd G. Smith, Nisha Krishnan. Climate Security Vulnerability in Africa Mapping 3.0, Political Geography (12 2014)
- 08/13/2014 55.00 Todd G. Smith. Feeding unrest:Disentangling the casual relationship between food price shocks and sociopolitical conflict in urban Africa, Journal of Peace Research (12 2014)
- 08/24/2015 16.00 Clionadh Raleigh, Caitriona Dowd, James Moody. Real Time Analysis of Political Violence, August 2015, ACLED Conflict Trends (08 2015)
- 08/27/2015 19.00 Krista Rasmussen, Ilse Mariana Munoz-Ramirez, Tiffany Wang. Climate Aid and Development: Annotated Bibliography, CCAPS Course Module (08 2015)
- 08/27/2015 20.00 Joshua Busby, Todd G. Smith, Nisha Krishnan. Climate Security Vulnerability in Africa Mapping 3.0: An Update, N/A (02 2015)
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- 08/28/2012 70.00 Edward K. Vizi, Kerry H. Cook, Julien Crétat, Naresh Neupane. 21st Century Climate Prediction for the Sahel: Are Greener Pastures Ahead?, Journal of Climate (07 2012)
- 08/28/2012 69.00 Kerry H. Cook, Edward K. Vizi. Climate Change over East Africa: Longer Short Rains and Shorter Long Rains, Journal of Climate (07 2012)
- 08/28/2012 68.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, July 2012, ACLED Conflict Trends (No. 4) (07 2012)
- 08/28/2012 67.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, June 2012, ACLED Conflict Trends (No. 3) (06 2012)

- 08/28/2012 66.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, May 2012, ACLED Conflict Trends (No. 2) (05 2012)
- 08/28/2012 65.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, April 2012, ACLED Conflict Trends (No. 1) (04 2012)
- 08/28/2012 63.00 Clionadh Raleigh. Scales of Conflict Research, INTERNATIONAL Interactions (11 2011)
- 08/28/2014 68.00 Jennifer Bussell. Institutional Capacity and Natural Disasters Course Module, CCAPS Course Module (09 2014)
- 08/28/2014 67.00 Robert Wilson. Climate Change and Cities in Africa: Current Dilemmas and Future Challenges, CCAPS Course Module (08 2014)
- 08/29/2013 10.00 Justin Baker, Sarah McDuff, Cathiner Weaver. Tracking Climate Aid in Africa: The Case of Malawi, CCAPS Research Brief Series (08 2013)
- 08/29/2013 11.00 Joshua Busby, Kerry Cook, Edward Vizey, Todd Smith, Mesfin Bekalo. Identifying Hot Spots of Security Vulnerability Associated with Climate Change in Africa, Climate Change (07 2013)
- 08/29/2013 13.00 Cullen S. Hendrix, Stephan Haggard. Global Food Prices, Regime Type, and Protest in the Developing World, Journal of Peace Research (07 2013)
- 08/29/2013 14.00 Michael G. Findley. Lootable Resources and Third-Party Intervention into Civil Wars, Conflict Management and Peace Science (06 2013)
- 08/29/2013 16.00 Lea Macias, Clionadh Raleigh. Complex Emergencies, CCAPS Research Brief Series (08 2013)
- 08/29/2013 17.00 Daniel Milton, Megan Spencer, Michael Findley. Radicalism of the Hopeless: Refugee Flows and Transnational Terrorism, INTERNATIONAL Interactions (10 2012)
- 08/29/2013 18.00 Abigail Ofstedahl, Elena Rodriguez, Justin Baker, Catherine Weaver. Tracking Aid for Food Security: Methodology and Pilot Case Study in Malawi, CCAPS Research Brief Series (08 2013)
- 08/29/2013 19.00 Peter Rudloff, Michael Findley. The Downstream Effects of Combatant Fragmentation on Civil War Recurrence, Journal of Peace Research (05 2013)
- 08/29/2013 20.00 Idean Salehyan, Cullen Hendrix. Climate Shocks and Political Violence, British Journal of Political Science (01 2013)
- 08/30/2011 18.00 Edward K. Vizey, Kerry H. Cook. Impact of future climate change on the sub-Saharan northern African growing season, Submission to Climate Dynamics (07 2011)
- 08/31/2011 24.00 Joshua Busby, Todd G. Smith, Kaiba White, Shawn M. Strange. The Sources of Climate Insecurity: Mapping Vulnerability in Africa, International Security (08 2011)
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- 08/31/2011 26.00 Sarah Fiorenza, Hoor Jangda, Gigi Mao, Dylan Malcomb. Climate Change and Aid in Malawi, Student WORKing Paper No. 6, CCAPS Student Working Paper Series (08 2011)

- 08/31/2011 27.00 Cullen S. Hendrix, Idean Salehyan. Climate Change, Rainfall Triggers and Social Conflict in Africa, Journal of Peace Research (08 2011)
- 08/31/2011 28.00 Derell Kennedo, Emily Joiner, Jesse Sampson. Vulnerability to Climate Change in West Africa: Adaptive Capacity in the Regional Context, Student Working Paper No. 4, CCAPS Student Working Paper Series (08 2011)
- 08/31/2011 30.00 Todd G. Smith. Fighting in the Rain: Monthly Rainfall Extremes and Social Unrest in Africa, Journal of Peace Research (04 2011)
- 08/31/2011 31.00 Edward K. Vizzy, Kerry H. Cook. Impact of Future Climate Change on the sub-Saharan Northn African Growing Season, Climate Dynamics (07 2011)
- 08/31/2011 33.00 Christine Ackerson, Emily Adams, Jon Arnold, Vera Magero, Amy Knop-Narbutis. Measuring International Development Assistance for Climate Change Adaptation in Africa, Student Working Paper No. 3, CCAPS Student Working Paper Series (08 2011)
- 08/31/2011 36.00 Nancy Peek, Valeria Schillaci, Jess Tibbets, Kellee Usher, Kathryn Yeager. Climate Change and Aid in Ethiopia, Student Working Paper No. 7, CCAPS Student Working Paper Series (08 2011)
- 08/31/2011 38.00 CCAPS researchers. Complete list of CCAPS manuscripts submitted in year 2, Manuscript (07 2011)
- 12/19/2012 74.00 Clionadh Raleigh, Caitriona Dowd. Real-Time Analysis of African Political Violence, November 2012, Conflict Trends (11 2012)
- 12/19/2012 73.00 Catherine Weaver, Justin Baker, Christian Peratsakis. Tracking Climate Adaptation Aid: Methodology, CCAPS Research Brief Series (09 2012)
- 12/20/2012 75.00 Ignatius A. Madu. Spatial Vulnerability of Rural Nigeria to Climate Change: Implications for Internal Security, THE INTERNATIONAL JOURNAL OF CLIMATE CHANGE: IMPACTS ANDRESPONSES (10 2012)

TOTAL: 60

Books

<u>Received</u>	<u>Book</u>
05/24/2012 46.00	Joshua W. Busby, Todd G. Smith, Kaiba L. White, Shawn M. Strange. Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?, New York : Springer, 2012: Springer, (06 2012)
07/12/2012 53.00	Todd G. Smith. "Fighting in the Rain: Monthly Rainfall Extremes and Social Unrest in Africa" in Climate Change and Pastoralism: Traditional Coping Mechanisms and Conflict in the Horn of Africa, Ethiopia: Institute for Peace and Security Studies and University for Peace, (06 2012)
07/12/2012 58.00	Catherine Weaver, Christian Peratsakis. Engineering Policy Norm Implementation: The World Bank's Transparency Transformation, Oxford, UK: Oxford University Press, (12 2012)
08/28/2015 23.00	Alan J. Kuperman. Constitutions and Conflict Management in Africa: Preventing Civil Wars through Institutional Design, Philadelphia: University of Pennsylvania Press, (07 2015)
TOTAL:	4

<u>Received</u>	<u>Book Chapter</u>
08/14/2014 62.00	Joshua Busby, Clionadh Raleigh, Idean Salehyan. The Political Geography of Climate Vulnerability, Conflict, and Aid in Africa in Peace and Conflict 2014, Boulder: Paradigm Publishers, , (03 2014)
08/29/2013 12.00	Joshua Busby, Clionadh Raleigh, Idean Salehyan. The Political Geography of Climate Vulnerability, Conflict and Aid in Africa, Boulder, CO: Paradigm Publishers, (12 2013)
08/29/2013 15.00	Katherine Kitterman, Michael G. Findley. Non-DAC Donors and the Changing Landscape of Bilateral Aid, New York : Routledge, (11 2013)
08/29/2013 21.00	Joshua W. Busby, Todd G. Smith, Kaiba L. White. Climate Security and East Africa: A GIS-Based Analysis of Vulnerability, Addis Ababa, Ethiopia: University for Peace, (08 2012)
08/29/2013 22.00	Todd G. Smith. Fighting in the Rain: Monthly Rainfall Extremes and Social Unrest in Africa, Addis Ababa, Ethiopia: University for Peace, (08 2012)
TOTAL:	5

Patents Submitted

Patents Awarded

Awards

N/A

Graduate Students

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
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FTE Equivalent:

Total Number:

Names of Post Doctorates

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
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FTE Equivalent:

Total Number:

Names of Faculty Supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
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FTE Equivalent:

Total Number:

Names of Under Graduate students supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
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FTE Equivalent:

Total Number:

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 0.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 0.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: 0.00

Names of Personnel receiving masters degrees

NAME

Total Number:

Names of personnel receiving PHDs

NAME

Total Number:

Names of other research staff

NAME

PERCENT SUPPORTED

FTE Equivalent:

Total Number:

Sub Contractors (DD882)

1 a. University of Denver

1 b. 2199 S University Blvd

Denver

CO

80208

Sub Contractor Numbers (c): W911NF0910077

Patent Clause Number (d-1):

Patent Date (d-2):

Work Description (e):

Sub Contract Award Date (f-1): 6/1/13 12:00AM

Sub Contract Est Completion Date(f-2): 6/30/16 12:00AM

1 a. Armed Conflict Location & Event Dataset

1 b. 1204 Dolan Drive

Sun Prairie

WI

53590

Sub Contractor Numbers (c):

Patent Clause Number (d-1):

Patent Date (d-2):

Work Description (e):

Sub Contract Award Date (f-1): 9/1/14 12:00AM

Sub Contract Est Completion Date(f-2): 12/31/15 12:00AM

Inventions (DD882)

Scientific Progress

See Attachment.

Technology Transfer

Joshua Busby, "Climate Security Vulnerability in Africa," CCAPS Close-Out Briefing for the U.S. Department of Defense, Washington, DC, June 23, 2016.

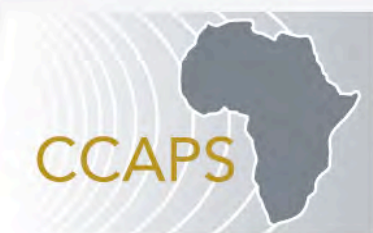
Clionadh Raleigh, "Outcomes and Impacts of the Conflict Tracking under the CCAPS Program," CCAPS Close-Out Briefing for the U.S. Department of Defense, Washington, DC, June 23, 2016.

Robert H. Wilson, "Urban Resilience to Climate Change in Africa," CCAPS Close-Out Briefing for the U.S. Department of Defense, Washington, DC, June 23, 2016.

Catherine Weaver, "Climate Change and Development: The Aid Scramble," CCAPS Close-Out Briefing for the U.S. Department of Defense, Washington, DC, June 23, 2016.

See Attachment for presentation slides.

THE ROBERT S. STRAUSS CENTER™
FOR INTERNATIONAL SECURITY AND LAW



CLIMATE CHANGE
AND AFRICAN
POLITICAL STABILITY

Climate, Conflict, and Governance in Africa: Pinpointing Risks and Opportunities

Final Program Report: 2009-2016

September 30, 2016

Climate, Conflict, and Governance in Africa: Pinpointing Risks and Opportunities

Final Program Report: 2009-2016

September 30, 2016

Program on Climate Change and African Political Stability¹

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¹ The name of the “Program on Climate Change, State Stability, and Political Risk in Africa” used in the initial grant proposal has been changed to the “Program on Climate Change and African Political Stability,” or CCAPS, for ease of reference.

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Program Overview

The Climate Change and African Political Stability Program is a multi-year research program based at the Robert S. Strauss Center for International Security and Law at the University of Texas at Austin, partnered with the College of William and Mary, Trinity College Dublin, and University of North Texas. CCAPS analyzes how climate change, conflict, governance, and aid intersect to impact African and international security.

Through quantitative analysis, GIS mapping, case studies, and field interviews, the CCAPS program seeks to identify where and how climate change could undermine state stability, to define strategies for building African state capacity, and to assess international development aid responses.

CCAPS is funded by the U.S. Department of Defense's Minerva Initiative, a university-based, social science research program focused on areas of strategic importance to national security policy. The CCAPS program works in three main areas:

Climate Change and Conflict

CCAPS examines where and how climate change poses threats to stability in Africa. This research examines the spatial and temporal relationship between climate change vulnerability and patterns of conflict, thereby specifying where, when, and how climate-related events could disrupt Africa's security and development. Research focuses on:

- *Climate Vulnerability*: Examines the environmental, population, socio-economic, and governance drivers of climate security vulnerability in Africa.
- *Future Climate Change*: New regional climate model for Africa generates mid-century climate projections to produce more near-term data for policy-relevant variables such as changes in growing season, precipitation, and heat index.
- *Social Conflict Analysis Database*: New database analyzes various forms of social and political unrest in Africa and Latin America.
- *Armed Conflict Location and Event Data*: Provides real-time tracking of the actions of opposition groups, governments, and militias continent-wide.

Governance

Climate change can contribute significantly to social stress, which, in the absence of effective governance, can lead to conflict within and between affected populations. CCAPS examines the role of government institutions in mitigating or aggravating the effects of climate change on political stability in Africa. Research focuses on:

- *Constitutional Design*: Explores how political institutions could buffer against conflict and other impacts of climate shocks.
- *Democratic Governance*: Assesses the effectiveness of democracy promotion in Africa as a way of building resilient societies and responsive governments.

- *National Disaster Response*: Examines the capacity of countries to respond to natural disasters, particularly those that may increase due to climate change.
- *Urban Resilience*: Assesses the capacity of metropolitan governance systems for disaster preparedness and response in urban areas.

International Aid

If effectively coordinated and implemented, aid for climate change adaptation should contribute to crisis prevention and adaptation and reduce the need for global assistance. Research focuses on:

- *Climate Change, Aid, and Development*: New geocoded, climate-coded dataset tracks adaptation aid, analyzes aid distribution, and assesses the effectiveness of adaptation projects in targeting climate security risks.

Chapter 1. Climate Security Vulnerability in Africa

Joshua W. Busby, The University of Texas at Austin

Todd G. Smith, University of Nevada, Reno

Nisha Krishnan, The University of Texas at Austin

Charles Wight, The University of Texas at Austin

Executive Summary

Climate change is expected to have severe consequences for millions of people around the world, but its effects will not be evenly distributed. The CCAPS Climate Security Vulnerability Model (CSVM) maps subnational climate change vulnerability in Africa to identify the locations of chronic vulnerability to climate security concerns. The CCAPS model has an explicit security focus, emphasizing situations where large numbers of people could be at risk of death from exposure to climate related hazards. Vulnerability is a multi-dimensional function of exposure to hazards, where people live, what resources households and communities have to protect themselves, and whether governments are willing and able to help them.

In development for several years, the latest version of the CCAPS model – CSVM 3.1 – represents a further refinement on the last iteration of the composite index of vulnerability released in April 2013.ⁱ The final version of the maps was published in a special issue of *Political Geography*ⁱⁱ and posted through the project’s online dashboard.ⁱⁱⁱ The model shows extensive vulnerability across the Horn of Africa (particularly in Somalia and to a lesser extent Ethiopia), South Sudan, in pockets around the Great Lakes, with higher areas of vulnerability throughout northern Nigeria and southern Niger, as well as West Africa in Guinea and Sierra Leone and coastal Mozambique.

As part of this vulnerability mapping exercise, the team carried out several extensions including a comparison of CSVM mapping results with a geo-referenced version of the EM-DAT International Disaster Database. EM-DAT patterns of disasters and mortality show similar patterns for Somalia but more extensive disaster events and affected populations in Kenya and South Africa, possibly a function of better reporting in those countries.

In addition, an alternative version of the composite index was prepared with projections of future climate change using findings from a downscaled regional climate model developed by Kerry Cook and Ned Vizzy (the regional climate model is discussed in more detail in section 2). Results suggest more extensive vulnerability throughout the Sahel band in Africa than in CSVM model results, suggesting the maps are potentially sensitive to choices of model specification.

Finally, the team also overlaid some dimensions of U.S. strategic interests on top of CSVM vulnerability maps, including piracy, terrorism, oil fields, mine sites, and embassies and consulates. These results produce different results for different indicators. This approach is suggestive of a methodology for thinking through U.S. strategic interests in Africa but might require more data development and use of classified data sources to realize the full potential of this approach.

Introduction

Climate change is expected to have severe consequences on the lives and livelihoods of millions of people around the world, but its effects will not be evenly distributed. As a result of accidents of geography, different locations face distinct sources of vulnerability based on their differential exposure to cyclones, storm surge, drought, intense rains, wildfires, and other physical phenomena. The exposure of human populations to such physical processes varies, with large numbers of people often concentrated along the coasts while other areas are much less densely populated.

Whether these populations are able to protect themselves from the worst consequences of exposure to climate related hazards is contingent upon other aspects, including their health status, level of education, and access to services. In many instances, even communities with high living standards and adequate access to information and services will find themselves tested by extreme events; how well they fare will be contingent on the willingness and ability of their governments to come to their aid in times of need.

The continent of Africa is thought to be among the locations most vulnerable to climate change, given both high exposure to climate change and relatively low community resilience and governance capabilities.^{iv} However, even within Africa, vulnerability is not equally distributed. With climate change adaptation looming ever larger as an important policy area, decisions must be made about where to concentrate resources, both from national sources as well as international ones. Understanding where climate vulnerabilities are located therefore has immense practical significance.^v

Project Purpose

This research aims to identify subnational locations of “climate security” vulnerability in Africa. Going beyond mere livelihoods-based analyses of vulnerability, this mapping project identifies the places where the worst consequences of climate change are likely to hit and put large numbers of people at risk of death. Such situations could become humanitarian emergencies that require the mobilization of emergency resources by local governments and donors alike, sometimes involving military mobilization by both or either to rescue affected people. Such situations may or may not escalate into incidences of armed conflict.

Over the past several years, CCAPS developed a model aiming to capture the factors that contribute to climate security vulnerability.^{vi} Now in its third iteration, the CCAPS model is called the 3.1 version of the Climate Security Vulnerability Model (hereafter CSV 3.1).

Study Design

The CCAPS model seeks to identify the places most likely vulnerable to climate security concerns within Africa at the subnational level. These are maps of chronic vulnerability, of places likely to be of perennial concern, rather than seasonal maps of emergent vulnerability like those produced by the Famine Early Warning Systems Network.^{vii} Unlike some global maps of

vulnerability,^{viii} CCAPS maps are relative to the rest of Africa, rather than the rest of the world, and have an explicit security focus, emphasizing situations where large number of people could be at risk of death from exposure to climate related hazards.

The CCAPS model starts with four baskets or processes—physical exposure, population density, household and community resilience, and governance and physical violence—that capture the salient sources of vulnerability. Each of these baskets, save for population density, is composed of multiple indicators. Subnational data with fine-grained resolution was used wherever possible. The initial CCAPS model weighted each basket equally and created a composite index by adding the four baskets together.^{ix}

Version 3.1 of the CSVM incorporates a number of changes to the existing approach.

More Localized Data

First, CCAPS was able to integrate more subnational data in this iteration of the model. For a number of indicators, particularly in the household and community resilience basket, data from the USAID Demographic and Health Surveys (DHS) were used to calculate subnational indicators. As a result, the CSVM 3.1 includes subnational data for six of the eight indicators in the household and community resilience basket.

Second, in previous iterations, the model relied on subnational boundary units from the Global Administrative Areas dataset.^x For this version, drawing on the latest boundaries that were available from multiple sources, the team created a master set of updated administrative boundaries across Africa, typically corresponding to regional boundaries of states or provinces.

A New Scale

The five-category, one to five scale used in previous model iterations had some disadvantages. Collapsing vulnerability scores into five whole numbers resulted in lost information. Standardizing scores in this way made it easy to visualize the data, but it proved less useful for trying to understand if a particular score lay closer to one whole number or another. As a consequence, in the 3.1 version of the model, all indicators are normalized on a scale from zero to one, using either percent rank to convey where a value fell between the minimum and maximum for that indicator^{xi} or percentiles.^{xii} Here, a value of one reflects no vulnerability (high overall resilience) while a value of zero reflects maximal vulnerability (no resilience).

Functional Form

Though the team has prepared alternative versions of the model with different formulas to aggregate the data,^{xiii} the basic form of the model uses a simple additive index, used in previous iterations of the model, and reflected by the equation:

$$\text{CSVM}_{\text{additive}} = \text{Climate Related} + \text{Population Density} + \text{Household Resilience} + \text{Governance}$$

Indicators in CSVM 3.1

Climate Related Hazard Exposure

CSVM 3.1 includes indicators for rainfall anomalies, chronic water scarcity, cyclones, wildfires, floods, and low-lying coastal zones (see Appendix A).

In terms of rainfall-related indicators, the previous version relied on a count of events and intensity of the Standardized Precipitation Index over the entire period 1980-2004.^{xiv} Rather than create a drought frequency count over the entire period of study, CSVM 3.1 uses *rainfall anomalies* of monthly observations of accumulated rainfall for the previous six months compared to a rolling twenty-year average for each calendar month.

Thus, if the accumulated rainfall deviates strongly from the previous patterns over the last twenty years, this could have a major impact on the ability of farmers and other water users to plan, plant, and execute their operations, with potential follow-on consequences for food production. Using data from the Global Precipitation Climatology Centre (GPCC), the research team calculated whether or not a given six-month period deviated strongly from the twenty-year average for the same six months. A rolling six-month standardized precipitation measure of anomalies was calculated for the period 1980-2009.^{xv}

While this indicator captures deviations from normal rainfall, the model also seeks to identify areas with *chronic water scarcity* by calculating the average monthly coefficient of variation.^{xvi} Again, CSVM 3.1 uses GPCC data, updated for the period 1980-2009. Values across the entire continent were generated for both of these indicators.

For the *cyclone* indicator, CSVM 3.1 uses a new indicator from the UNEP/GRID-Europe platform called “sum of winds.” It is meant to capture both frequency and speed of cyclone events. It is measured in kilometers per year and provides values for the period 1970–2009.

Previous versions of the model utilized data from UNEP/GRID-Europe on physical hazards. UNEP/GRID-Europe has since updated data sources, including wildfires. CSVM 3.1 includes a *wildfires* indicator for the period 1995-2011, which provides several additional years of data.

In terms of the other indicators, the *flood* indicator and the *low-elevation coastal zones* indicator remained unchanged from the previous iteration of the model.

Given that both the *rainfall anomalies* and *chronic water scarcity* indicators were meant to capture similar phenomena related to the effects of changes in rainfall, CSVM 3.1 divides the weight between them. Where *floods*, *cyclones*, *wildfires*, and *low-lying coastal zones* indicators each represented 20 percent of the overall climate related hazard or physical exposure basket, that 20 percent was split equally between rainfall anomalies and chronic water scarcity.

Combining these six indicators into a single basket map of climate related hazard exposure yields a map showing a band of high physical exposure extending from Somalia through Ethiopia and South Sudan, extending across parts of the DRC and Congo, and including parts of Gabon and Cameroon. In North Africa, parts of Egypt and northern Sudan, along with parts of Tunisia and Algeria, face high exposure. In Southern Africa, the eastern edge of Madagascar, coastal Mozambique, and pockets in South Africa also face high exposure (see [Figure 1](#)).

Figure 1

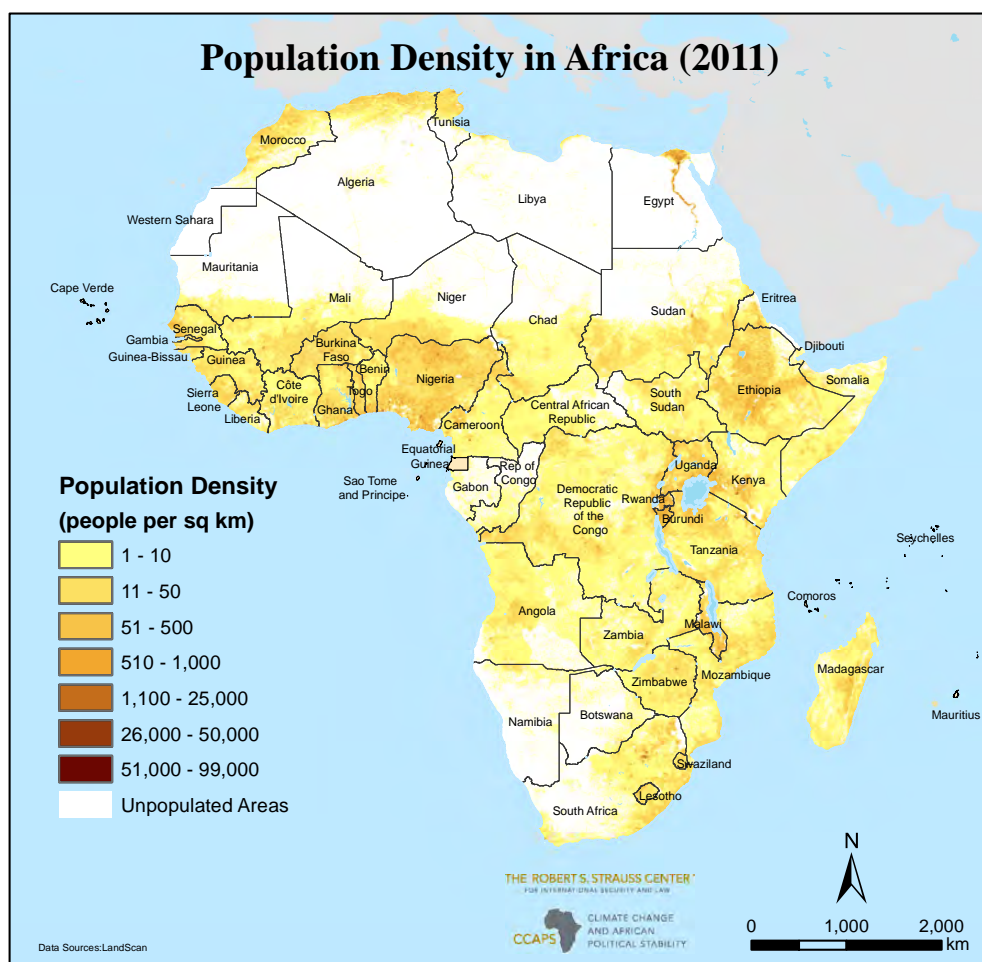


Population Density

The version 3.1 of the model uses updated 2011 data for LandScan population density data. Given the extreme spread of the data, the data is converted into a logarithmic scale before normalizing into percentiles on a zero to 1 scale (see Appendix B).

Figure 2 maps the raw data before normalization. Population concentrations are found in western Ethiopia, throughout Nigeria and neighboring coastal West Africa, in and around the Great Lakes region, Egypt, along Lake Malawi, and across parts of the Mediterranean coastline of Morocco and Tunisia. It should be noted that, in Figure 2, the range of the most densely populated areas (shown in dark brown) is enormous, from 48 people per square kilometer to 99,055 people per square kilometer.

Figure 2



Household and Community Resilience

This basket contains four categories of paired indicators for a total of eight indicators: two for education, two for health, two for access to daily necessities, and two for access to healthcare. In previous iterations of the model, only three of these indicators contained subnational information: infant mortality, underweight children, and access to improved drinking water sources.

In this iteration of the maps, CCAPS obtained updated *infant mortality data*, normalized to the year 2008, from the Global Climate Change Research Program.^{xvii} In addition, the team used new data from the USAID DHS program and the UNICEF Multiple Indicator Cluster Surveys (MICS) to derive new subnational indicators for *adult literacy* and *school enrollment* and to update indicators on *access to improved water sources* and *underweight children*.

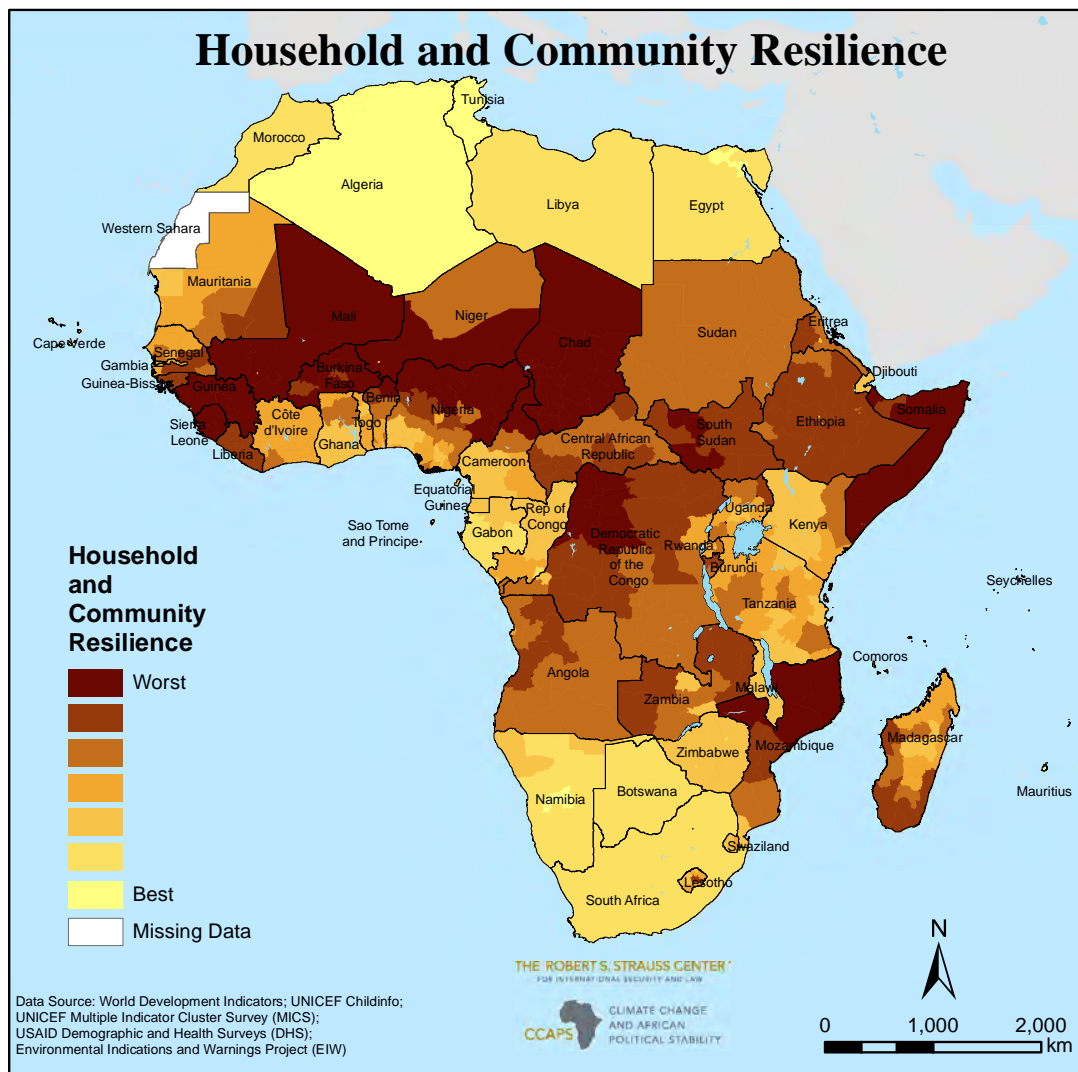
Finally, the new model uses subnational information for *delivery in health facility* from those same surveys, since delivery in a health facility is arguably a better proxy for access to health services than the national indicator of the number of midwives and nurses used in the previous

model.^{xviii} CSVM 3.1 thus uses subnational data for six of eight indicators in the household and community resilience basket (see Appendix C).

These data were converted into percent ranks and normalized on a zero to one scale. All four categories received equal weight in the index of 25 percent. Each indicator in the category thus receives 12.5 percent of the weight of the whole basket. In the event a particular indicator was missing data, the other indicator takes on the full 25 percent category weight.

Combining all these indicators in a single map yields Figure 3, which shows that the areas with the least household and community resilience are located in Somalia, Nigeria, and across the Sahel. The most resilient areas (the areas where communities have the highest levels of education, better health conditions, and access to necessities and health services) are located on the island of Mauritius and primarily in North Africa, including Tunisia, Algeria, Egypt, and Libya.

Figure 3



Governance and Political Violence

The model contains five categories of indicators and six indicators, including government responsiveness, government response capacity, openness to external assistance, two indicators for political stability, and presence of violence (see Appendix D). Of these, only one contains subnational information. In CSVM 3.1, these indicators have been updated to include more recent data. In North Africa, this is particularly important since the region experienced historic transformations in political stability since 2010.

CSVM 3.1 uses indicators for *government effectiveness* and *voice and accountability* updated through 2012. These indicators are represented through a diminishing four-year weighted-average, with data for 2012 assigned the most weight, followed by data from 2011, 2010, 2009, and 2008.^{xix}

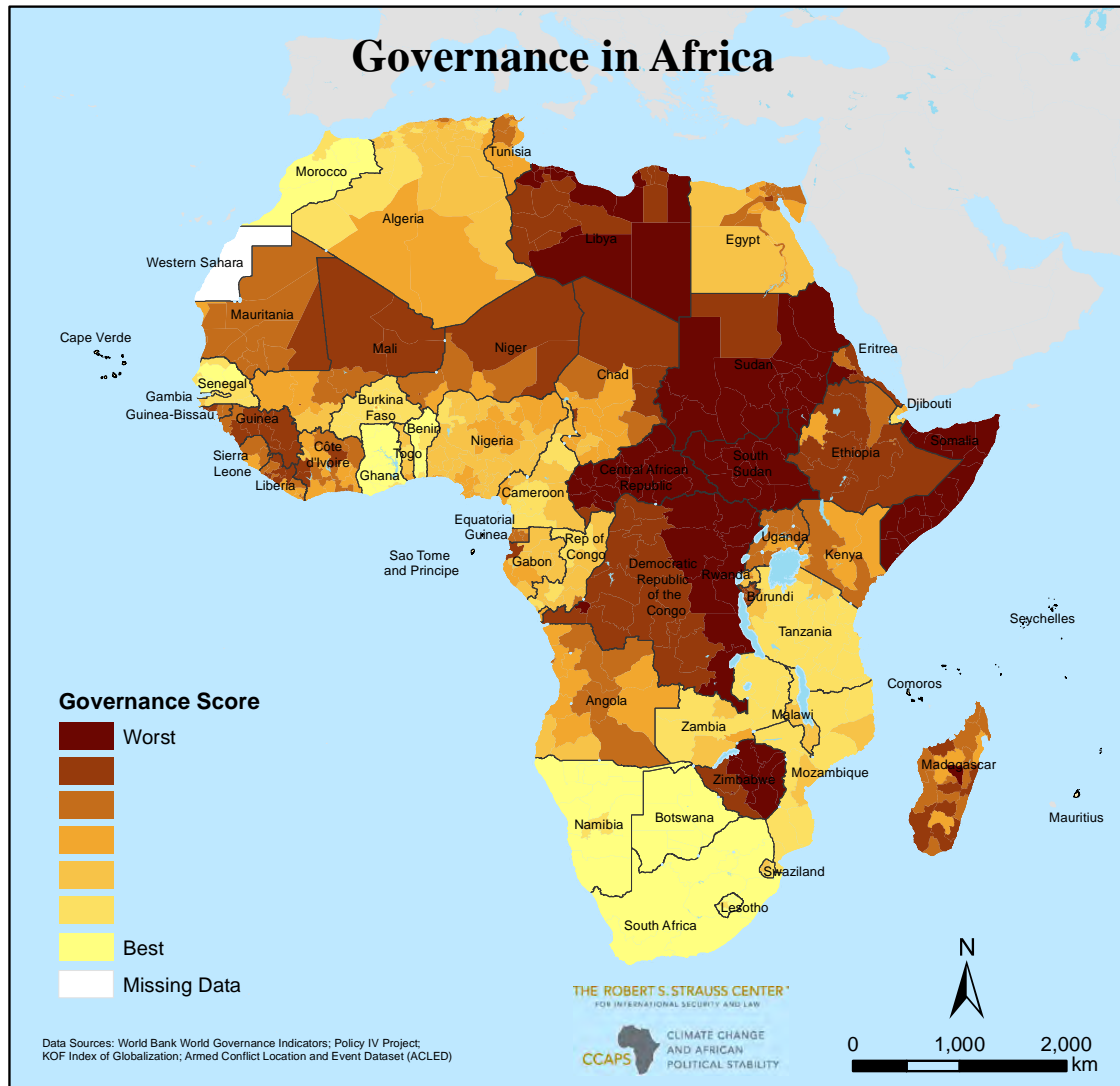
The indicator for *openness to external assistance* is from a single year from the 2011 KOF Index of Globalization, which appears to be a slow-changing indicator.

In terms of political stability, the new model takes advantage of the release of Polity IV data through 2013. The indicator of *polity variance* now covers the period 2004-2013.

Finally, as before, the sole subnational indicator in this basket is for *political violence* from the Armed Conflict and Location Events Dataset (ACLED). The measure here encompasses all categories of ACLED events for the period 1997-2013. This iteration places more weight on recent events compared to more distant ones.^{xx} The sum of ACLED events are generated at the level one administrative unit.^{xxi}

Combining these indicators into a single map yields Figure 4. It shows that the areas with the worst governance include most of Somalia, pockets in both South Sudan and Sudan, parts of the DRC, much of Libya (picking up on civil war and political instability after the Arab Spring), and the Central African Republic. By contrast, areas with the best governance scores include several island countries (Mauritius, Cape Verde, and the Seychelles) as well as much of Botswana, pockets in Morocco (in the Sud region), Namibia, Ghana, and South Africa.

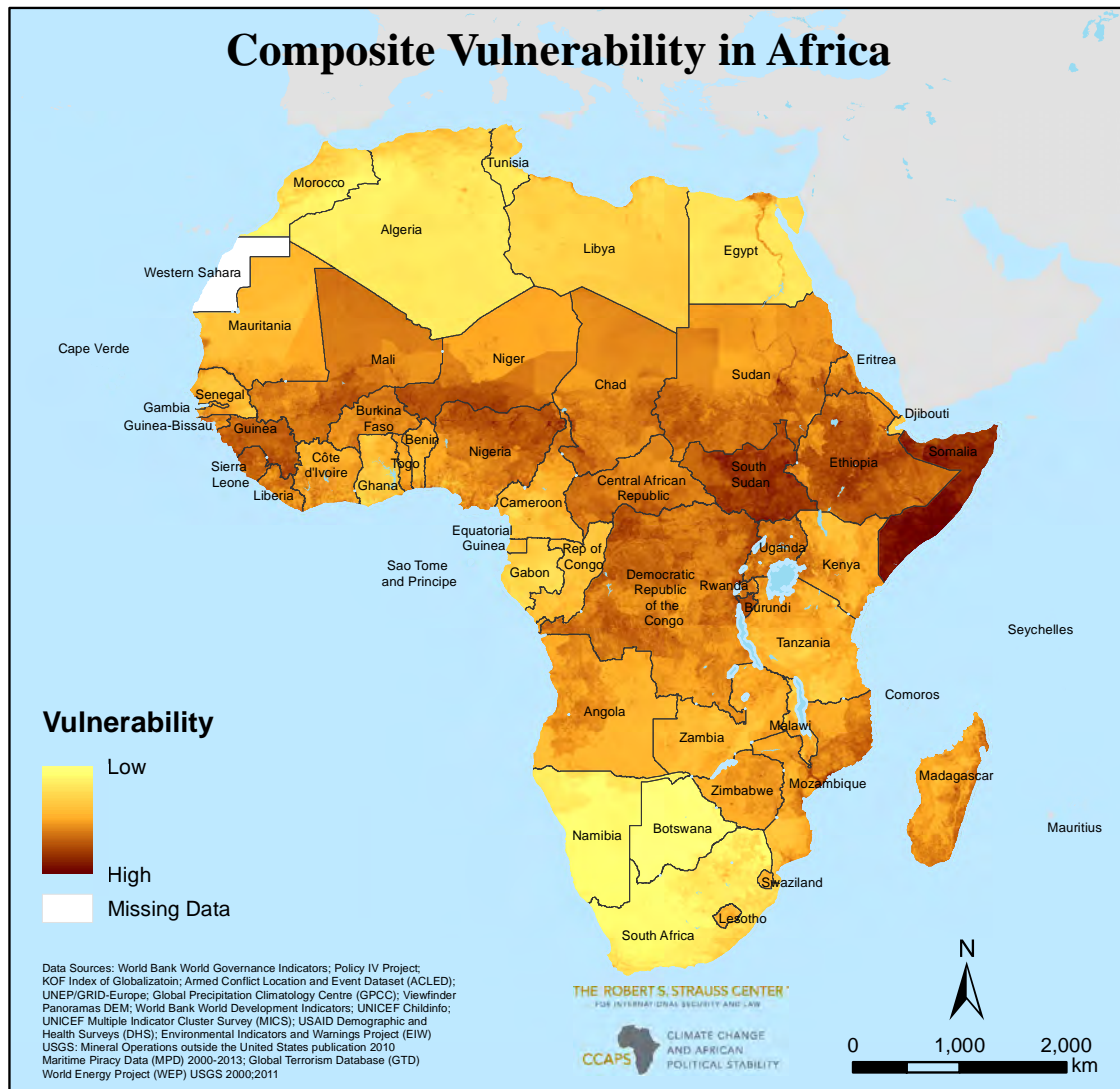
Figure 4



Findings

The model combines all four baskets to produce a composite score, using the additive function used in the previous iteration of the model (see Figure 5).

Figure 5



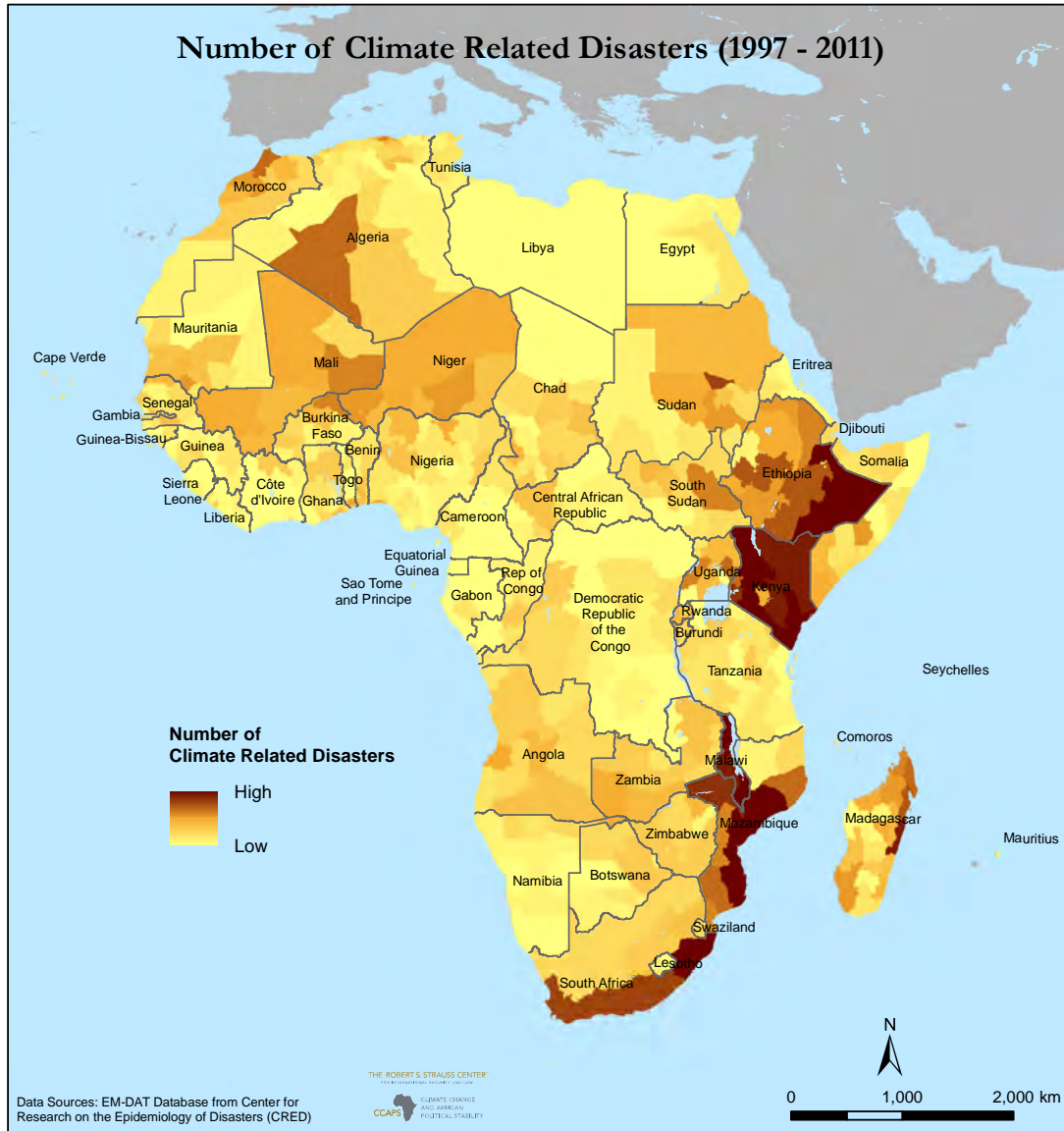
Somalia, western Ethiopia, and pockets in west Africa (in and around Guinea and Niger) retain the high vulnerability recorded in earlier iterations of the CCAPS model. Northern Nigeria appears more vulnerable in this iteration, a function of more differentiated data on household resilience that shows low household resilience in the north. Patterns in the DRC are similar to earlier versions as well, though somewhat diminished, a function of a more nuanced way of representing the data.

As always, one of the more challenging questions is the extent to which the maps are indicative of any real phenomena in the world. Are the locations identified as most vulnerable the same ones that come up as vulnerable in other studies?

To answer this, it is necessary to find a relevant comparison set of data compiled by others for similar purposes. Here, the EM-DAT International Disaster Database compiled by the Université Catholique de Louvain in Belgium may be a suitable candidate for assessing the external validity of the CCAPS model. The EM-DAT database records situations that already rise to a certain level of damage to be included in the database.^{xxii}

EM-DAT events include a variety of climate related “disasters.”^{xxiii} The geographic coordinates in EM-DAT are not very precise, with a disaster location usually identified by a town or province name, several provinces or regions, or sometimes the country as a whole. CCAPS geocoded these events for the period 1997-2012 by linking them to the CCAPS level one administrative regions, with individual events sometimes linked to more than one region or even the country as a whole.^{xxiv} Figure 6 shows the patterns in frequency of climate related disaster events in EM-DAT, which can be compared to the patterns in the CCAPS model.

Figure 6



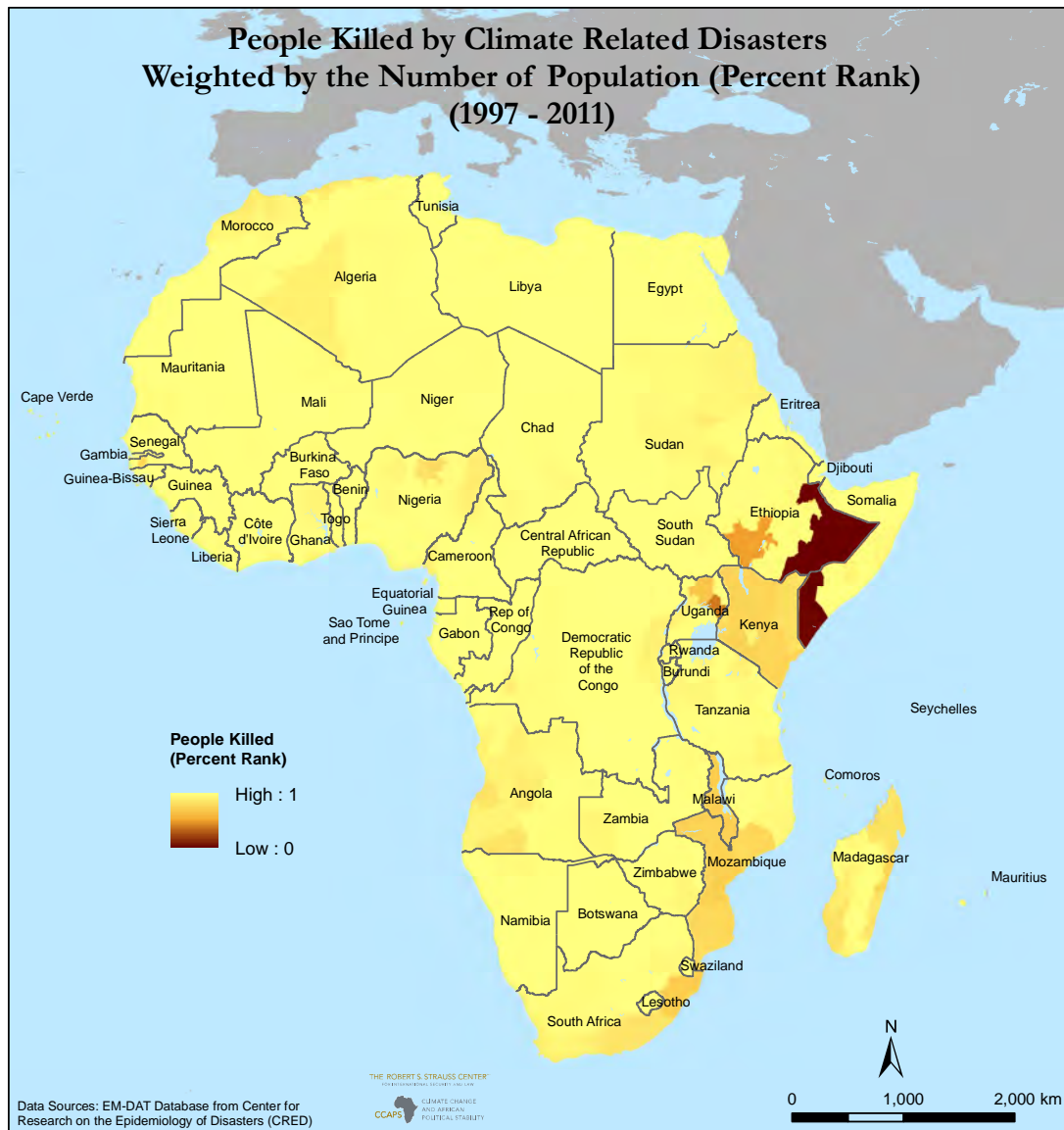
EM-DAT disaster events are concentrated in the Horn of Africa, the Sahel, and coastal Southern Africa. As in EM-DAT, areas in the Horn, Madagascar, coastal Mozambique, northern Nigeria, and southern Niger correspond to high vulnerability areas in CSVN 3.1. Results are also compared to the death and affected counts for disasters from EM-DAT. Here we show the comparison with deaths counts in Figure 7.^{xxv}

There are, however, also areas of high disaster frequency in EM-DAT (such as some regions in Kenya and South Africa) that the CCAPS model does not show as being highly vulnerable. This underscores the limits to a simple visual correlation.^{xxvi}

One observation is that the event counts in South Africa and Kenya may be a function of better reporting and information (the same may be true of casualty counts). EM-DAT estimates of

affected populations and deaths relies on Red Cross reports and other humanitarian agencies. Somalia has notoriously been a difficult place for both media and humanitarian actors to operate, making it likely that EM-DAT undercounts those affected by climate related events there.

Figure 7



Given the vagueness of the geographic details in EM-DAT, connecting EM-DAT events to level one administrative units is better than nothing. In short, this exercise to compare the CCAPS model findings to EM-DAT is a rough first cut at validating the CCAPS model results.

Another way the research team sought to validate the results is to compare the CSVM model efforts with projections of future climate change. As discussed in section 2, Kerry Cook and Ned Vizzy have developed a down-scaled regional climate model. That model includes a simulation of the late 20th century climate and a projection for the middle of the 21st century. A previous joint

paper was published in *Climatic Change* based on a single mid 21st century model run.^{xxvii} As discussed in section 2, the second iteration including multiple model runs for the mid 21st century.

The joint effort with Cook and Vizzy yielded a version of the composite vulnerability index which substituted model results from the downscaled regional climate models for most of the indicators in the physical exposure basket. The Cook and Vizzy climate model generated three indicators which are similar but not identical to those used in the original physical exposure basket. To capture a proxy for drought, the model generated a value for *dry days*, days where rainfall levels fell below 1mm for at least 21 consecutive days. To get at something equivalent to flood events, the model generated a value for *extreme rainfall days*, defined as the number of days per year when the daily rainfall rate exceeds a threshold of the 95th percentile of wet days. To capture areas potentially vulnerable to fire risk, the model generated a value for *heat wave events*, defined as number of days when the temperature exceeds 41 °C for at least 3 consecutive days. The physical basket also included the low elevation coastal zone indicator from the physical basket from the CSVM.

These indicators were normalized on a zero to 1 scale using the minmax transformation described earlier, where we evaluate each pixel's relative score in percent rank relative to the rest of the distribution of scores for that particular indicator. This allows us to convert indicators from different scales to be on the same scale.

This physical basket was combined with the three other baskets from the CSVM – population, household and community resilience, and governance. These were kept constant to see how the continent's climate security vulnerability might change, based on physical changes alone.

Extreme rainfall is, of course, a problematic proxy for flood indicators since these typically are based on river basin catchment data. Heat wave events too are an imperfect proxy for fire events. Nonetheless, these indicators were used as a way of simulating the late 20th physical environment and projecting to the middle of the 21st century.

The patterns are somewhat mixed since some areas in the Sahel are projected to get wetter with fewer dry days but with more heavy rainfall events. Parts of the Sahel are also projected to experience higher temperatures. These can be observed in a series of maps, one depicting the late 20th century simulation, another the mid-21st century projection, and the third a difference map comparing the mid-21st century to the late 20th.

The sequence for dry days can be observed in Figures 8, 9 and 10. In Figure 10, the blue areas show parts of the Sahel getting wetter while the red areas in north Africa, southern Africa, and parts of the Great Lakes experiencing more dry days, between a week to a month more every year.

Figure 8

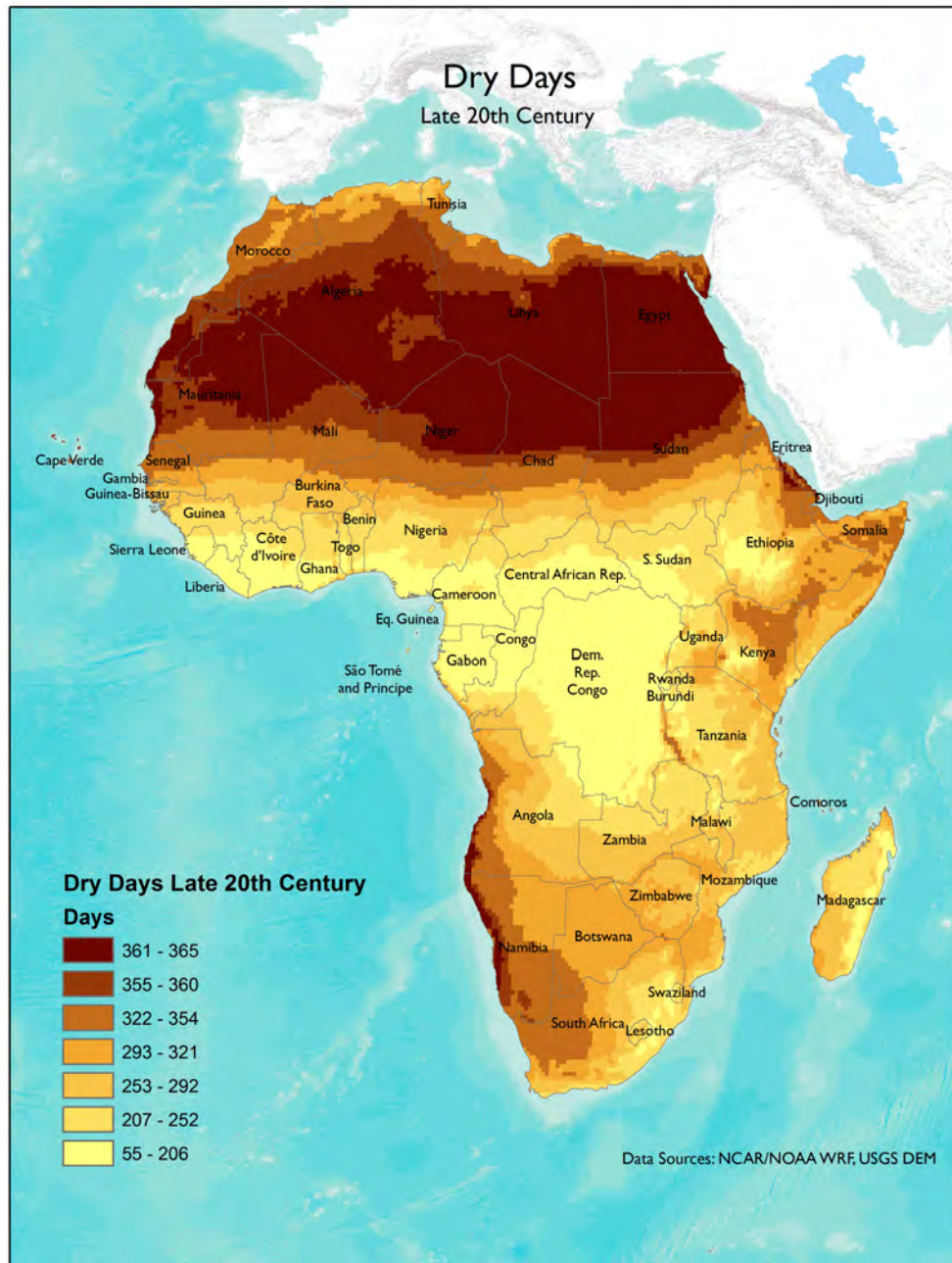


Figure 9

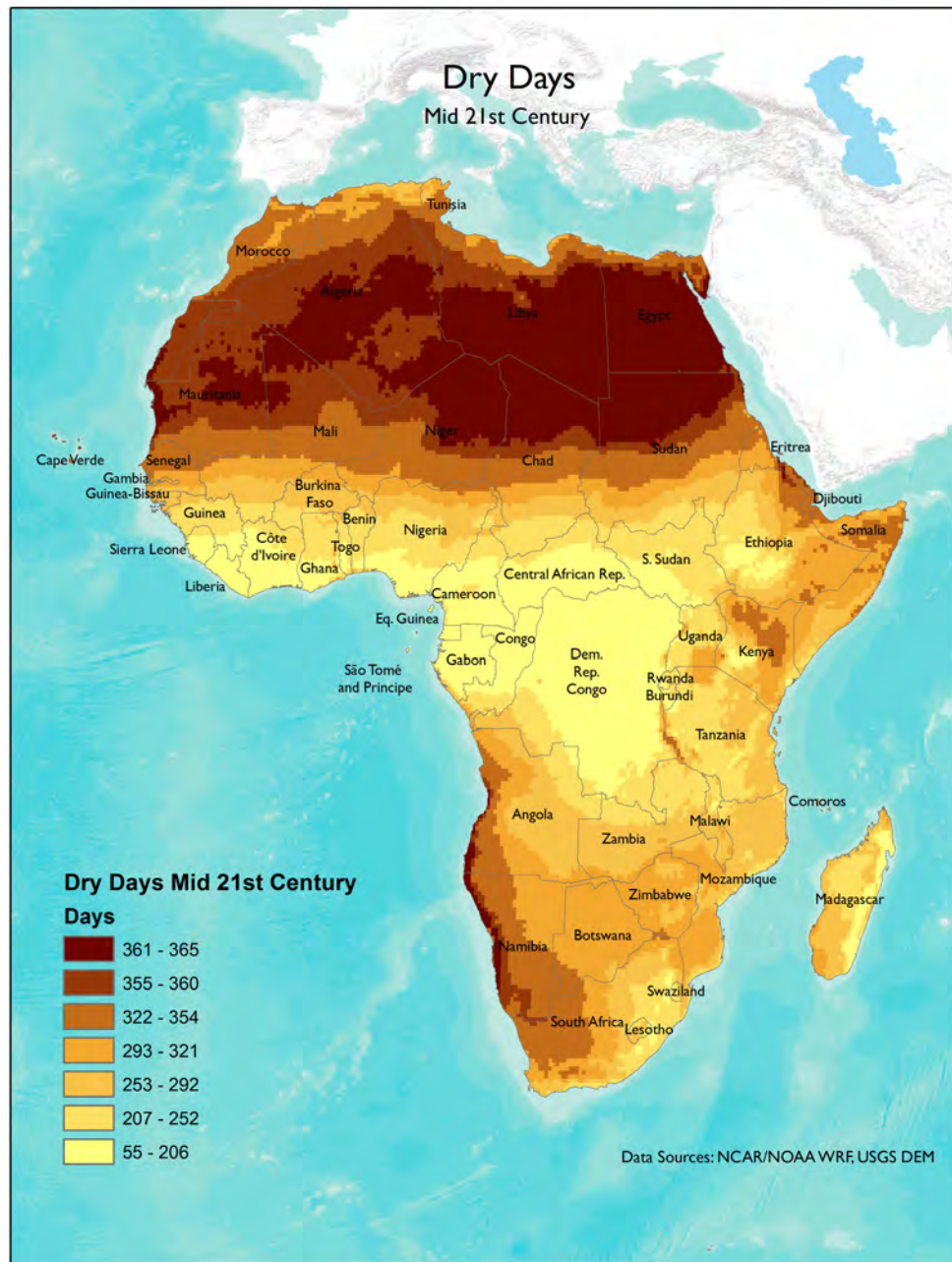
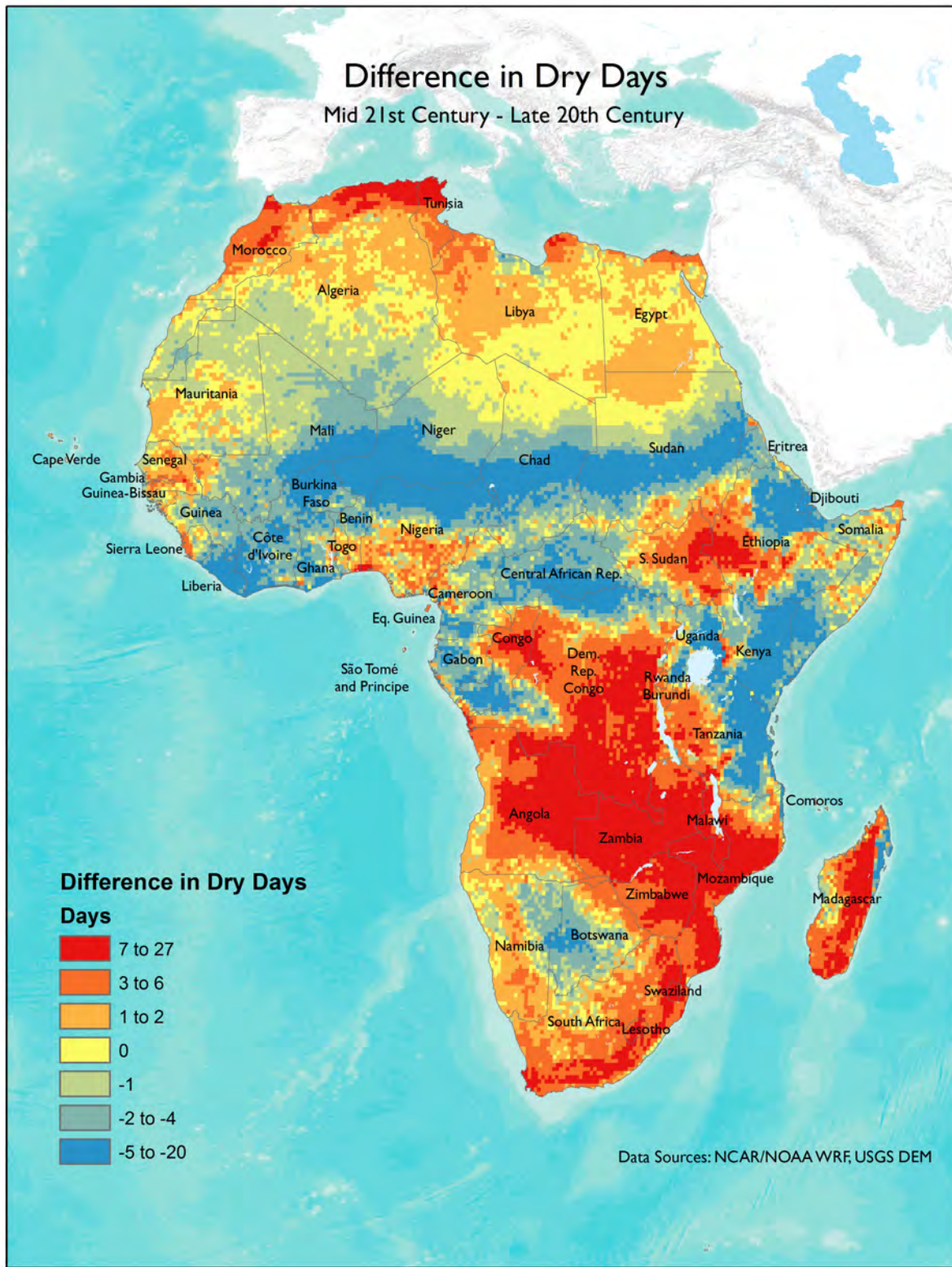


Figure 10



While fewer dry days is likely good for the Sahel, when we look at heavy rainfall events, we also see that the Sahel is also projected to receive heavier rainfall events, which could be problematic. Figures 11, 12, and 13 show the late 20th, the mid 21st projection, and the difference maps in succession. Figure 13 shows a band of heavier extreme rainfall days in red across the Sahel with declines in heavy rainfall events through central and southern Africa.

Figure 11

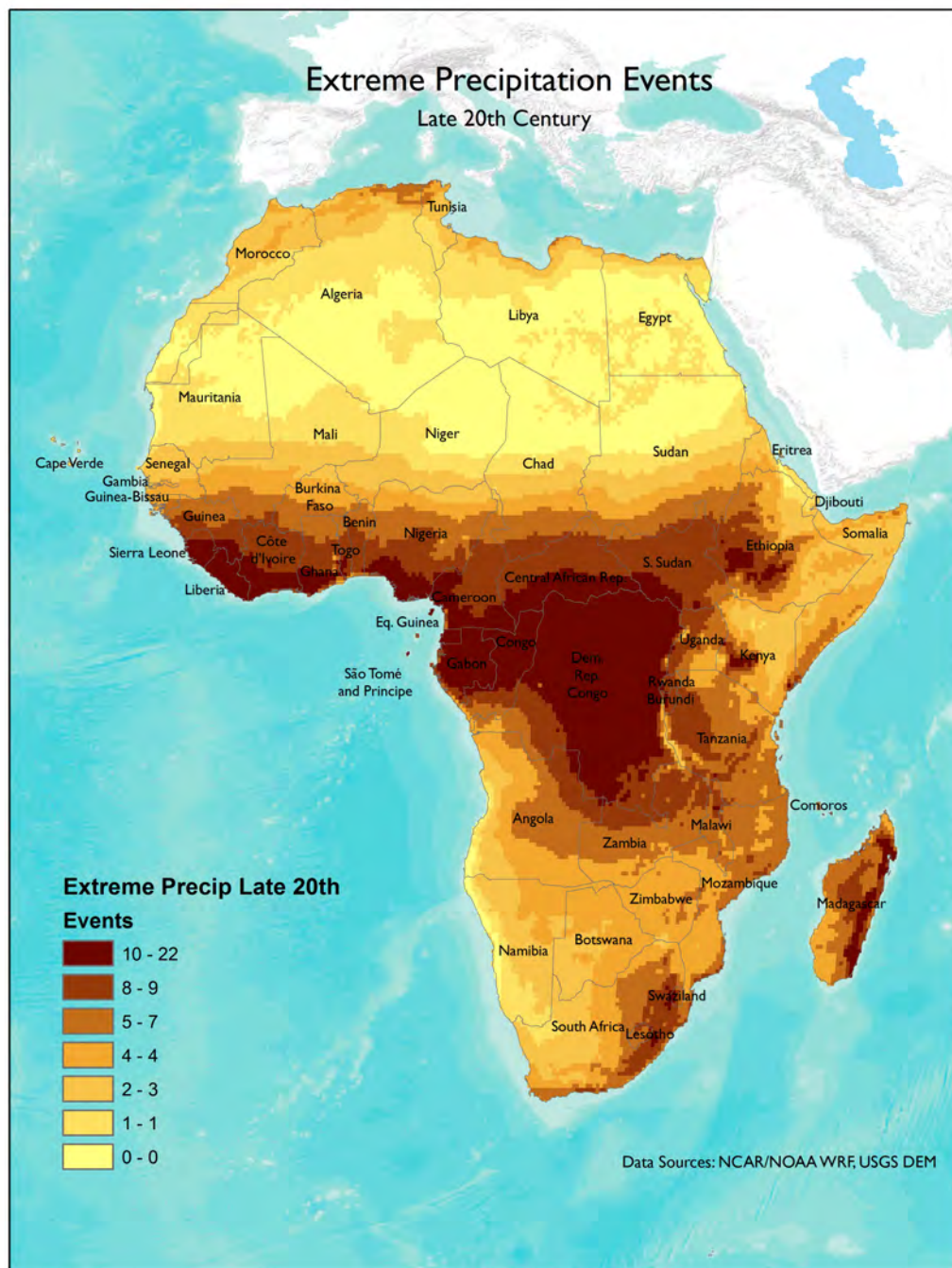


Figure 12

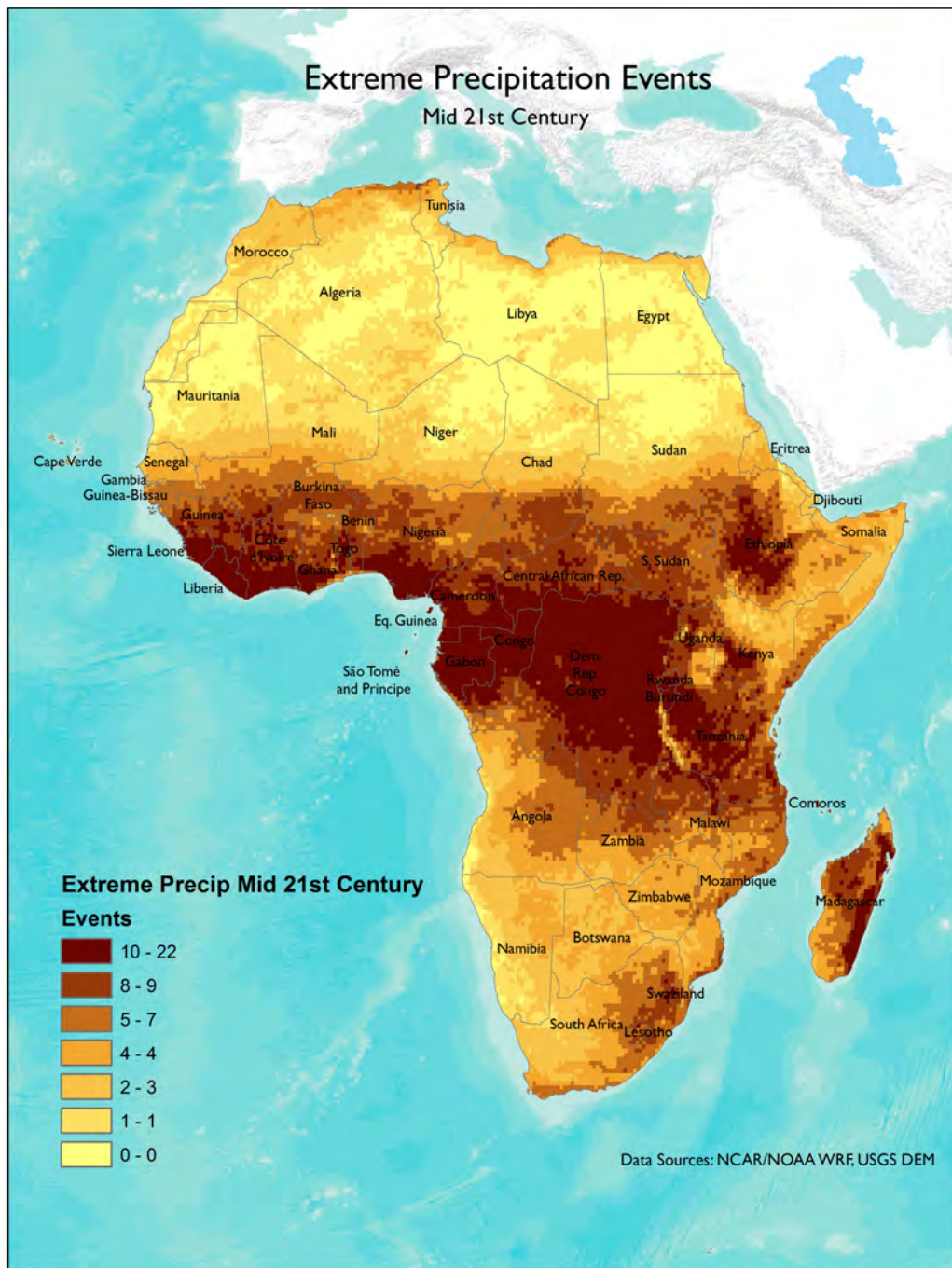
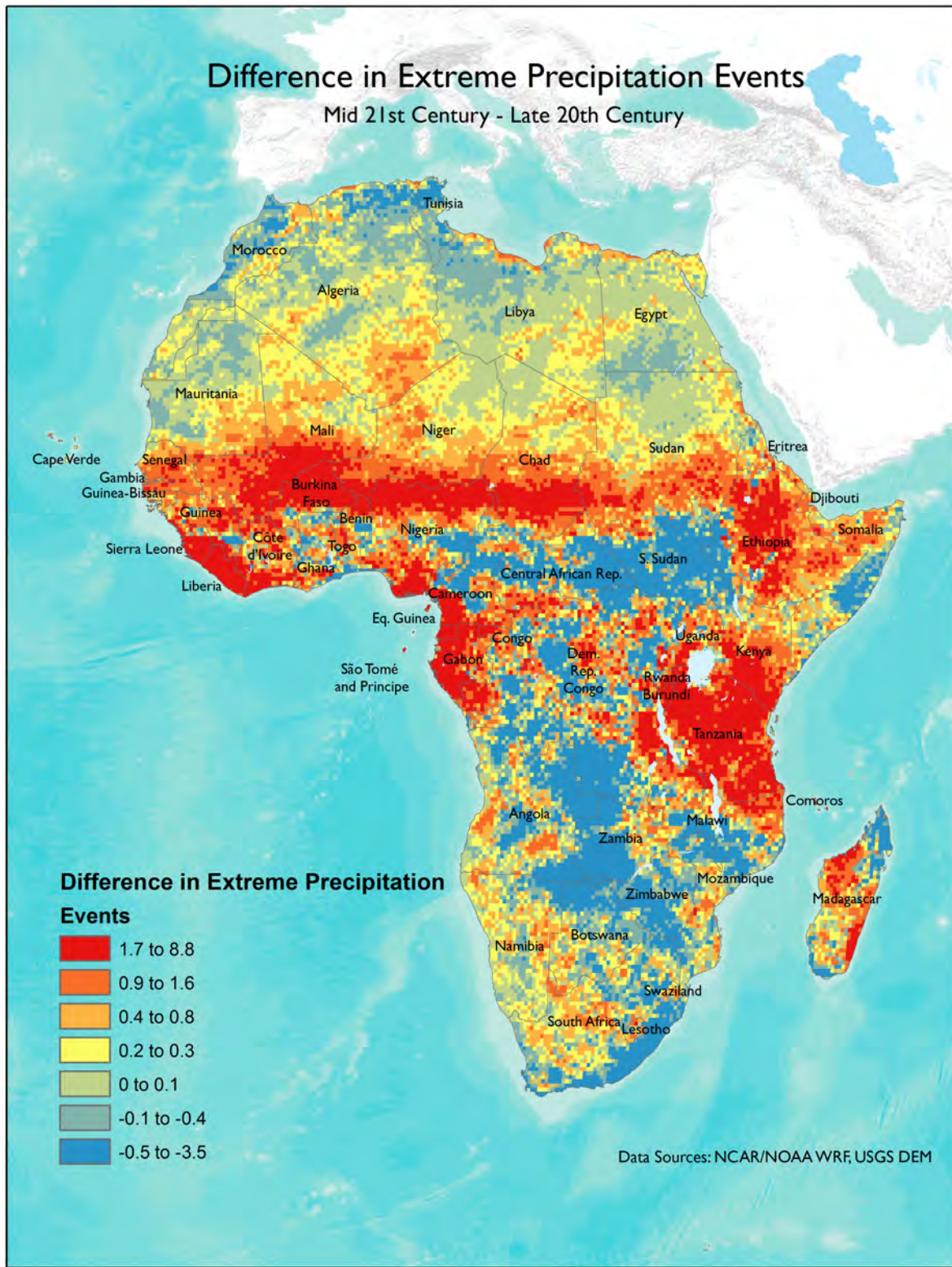


Figure 13



In terms of heat wave days, the maps show in Figures 14, 15, and 16 show a dramatic rise in heat wave events in West Africa in the northern part of the Sahel extending across to parts of Sudan. These are shown in red in Figure 16.

Figure 14

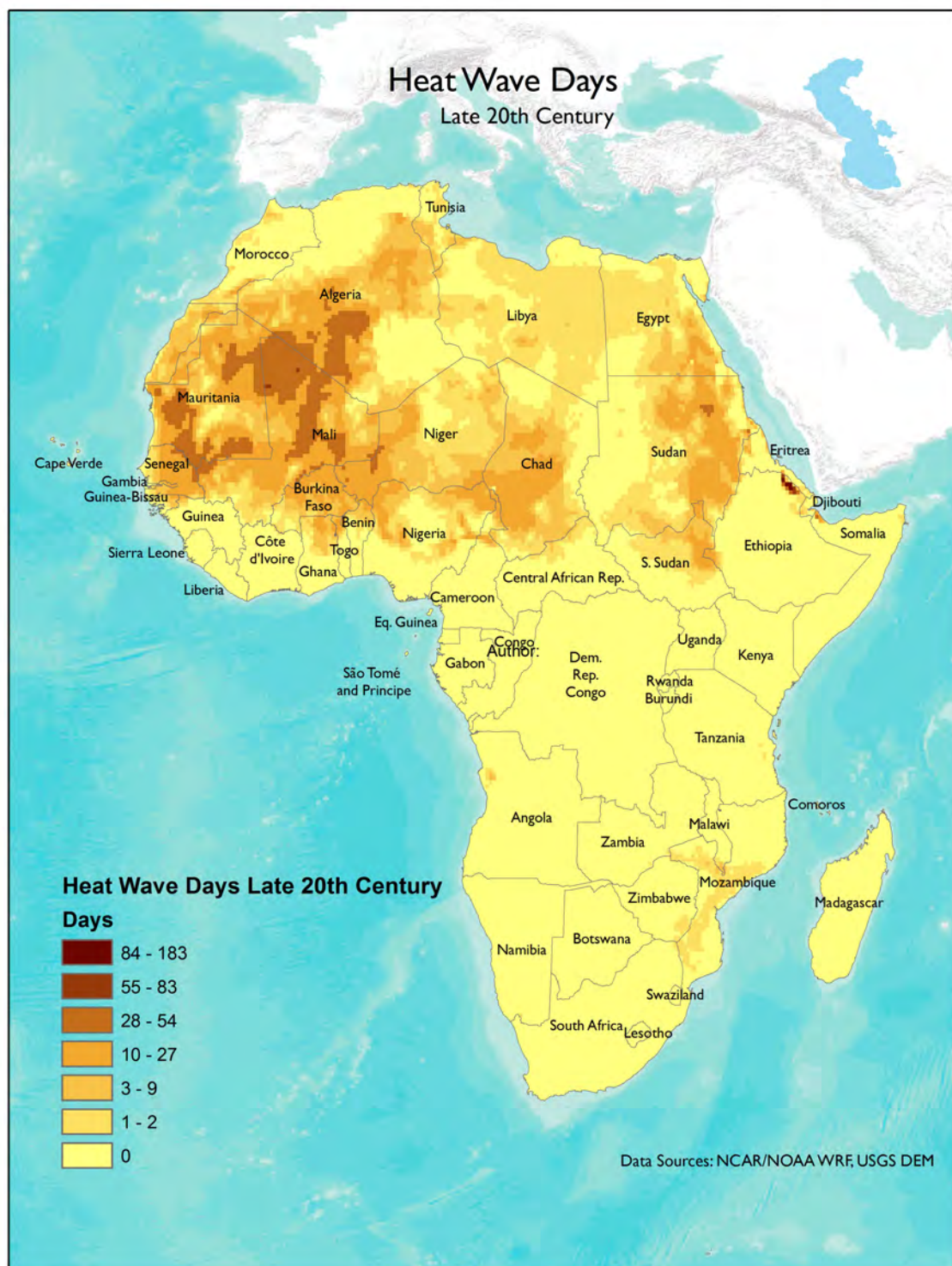


Figure 15

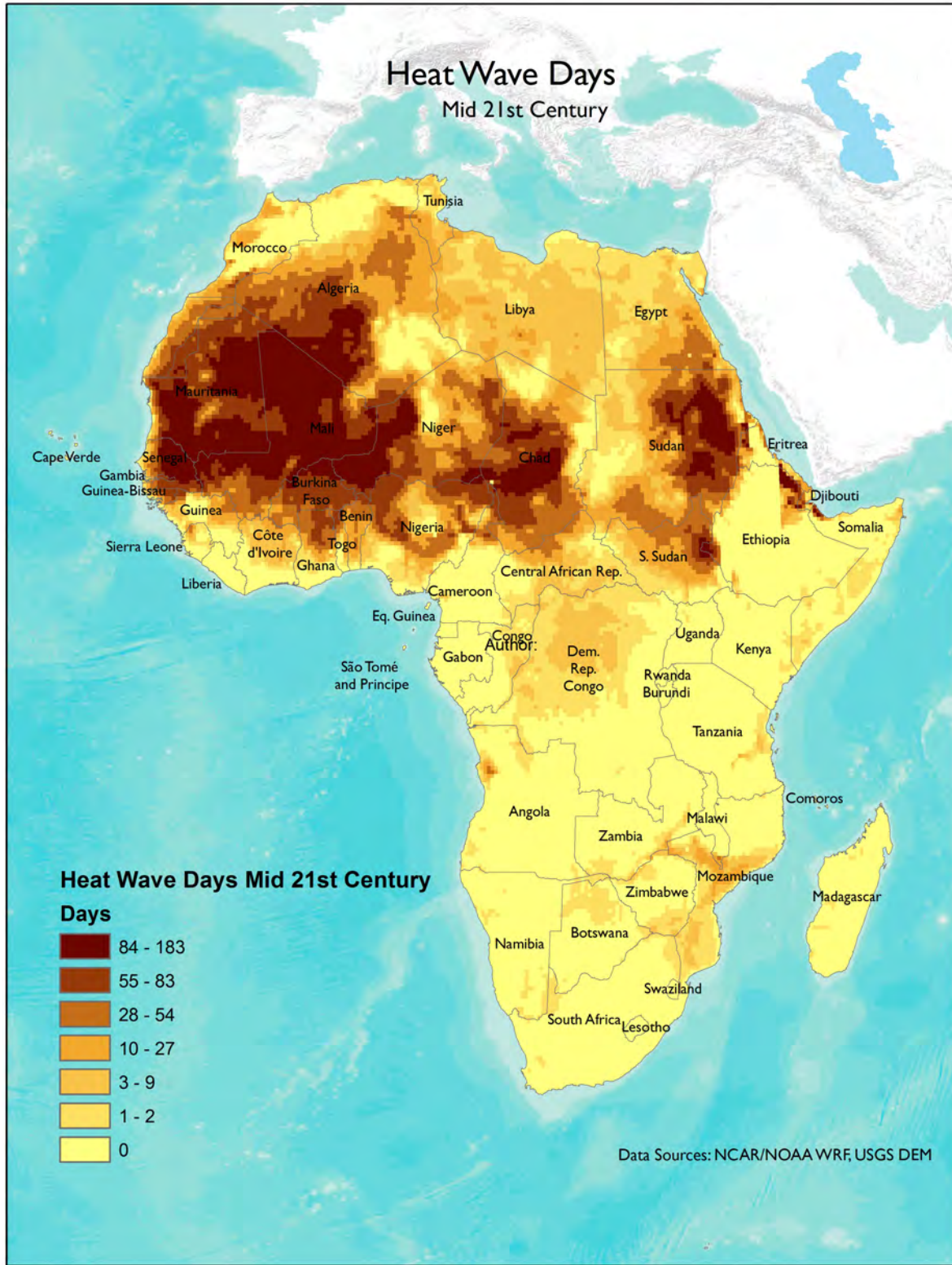
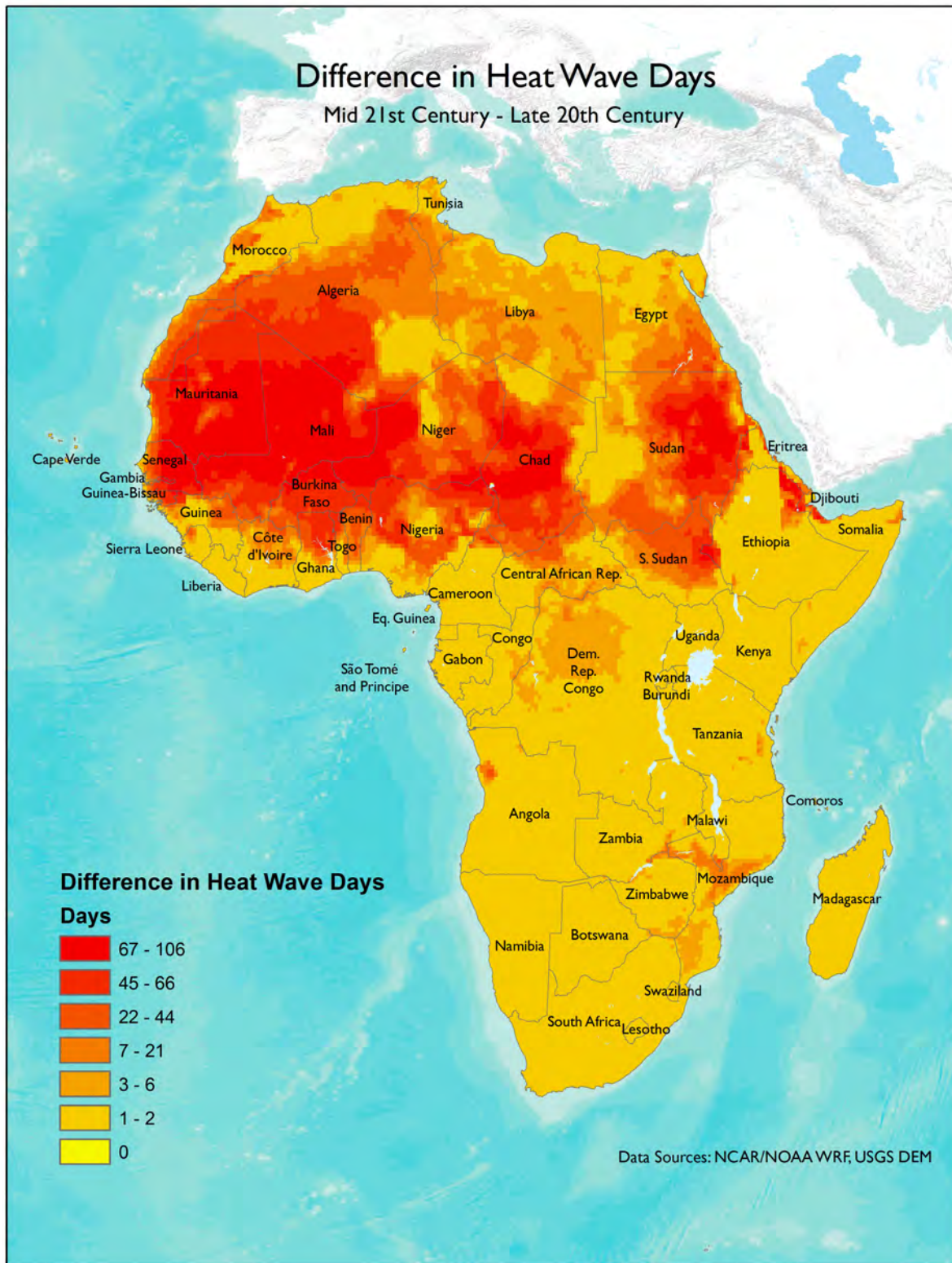


Figure 16



Combining these and the low elevation coastal zone indicator into a physical basket yields the following pattern for the late 20th century simulation and the mid 21st century projection (see

Figures 17 and 18). Since the data are normalized on the same scale, one cannot see a change in the absolute vulnerability. What the two maps show is that the Sahel band and southern Africa retain their distribution of vulnerability relative to the rest of the continent (along with pockets in coastal areas including Egypt). There is some modest darkening in West Africa, but the pattern is fairly similar.

What is notable is that the patterns of physical vulnerability for the late 20th century are fairly different to Figure 1 from the CSV. Where the Sahel comes out strongly in Figure 16, east and central Africa appear more physically exposed in the CSV maps of historic exposure to climate hazards. This raises the question of which maps captures the underlying reality better for the purposes of the study.

The CSV is based on historical data and includes more and different indicators (different indicators for water anomalies, the inclusion of cyclones and wildfires, and a river basin-based indicator of floods). Given the differences between source indicators, it is difficult to judge if one of these maps is a more accurate depiction of overall physical vulnerability relevant for large-scale loss of life and/or climate-related conflict.

Figure 17

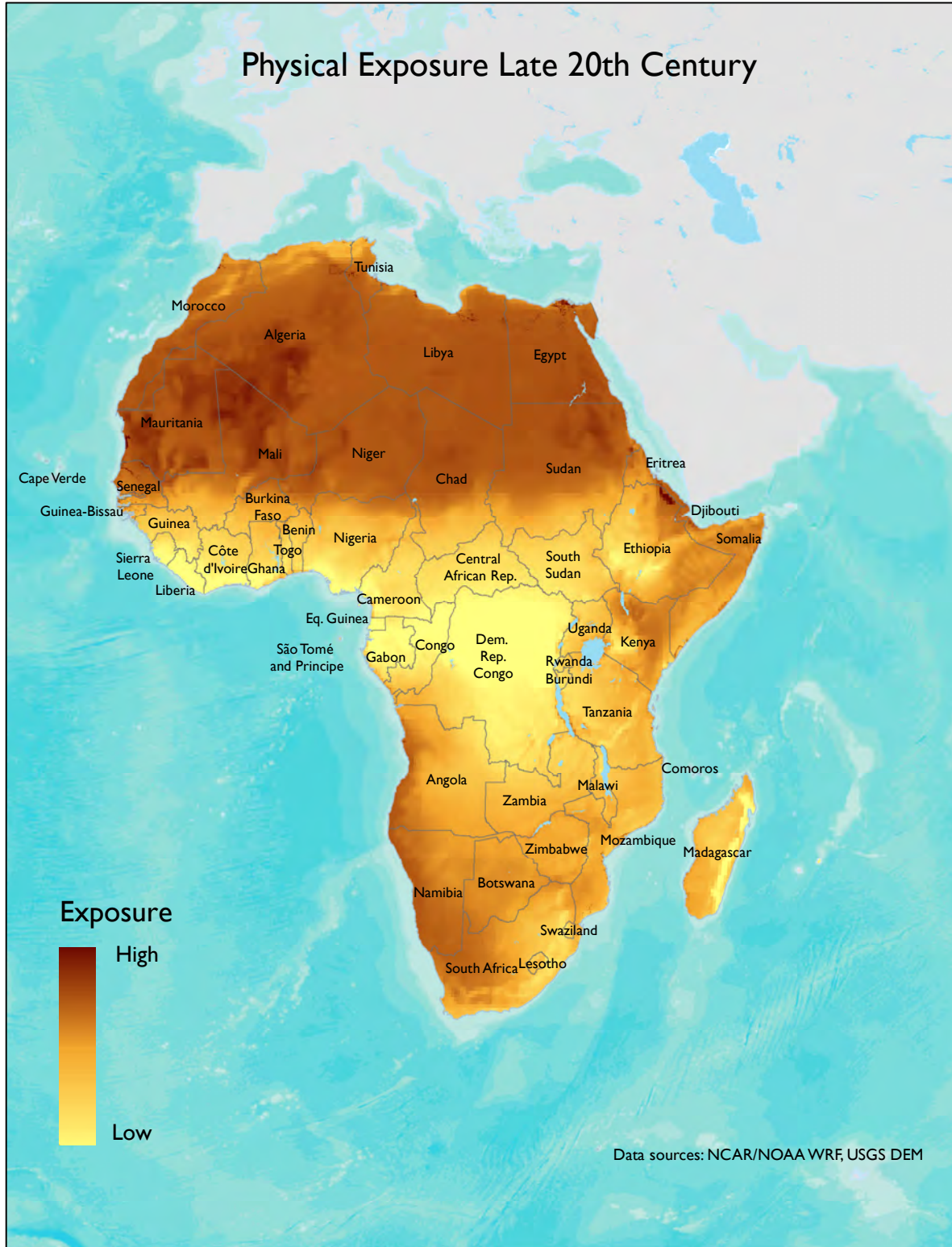
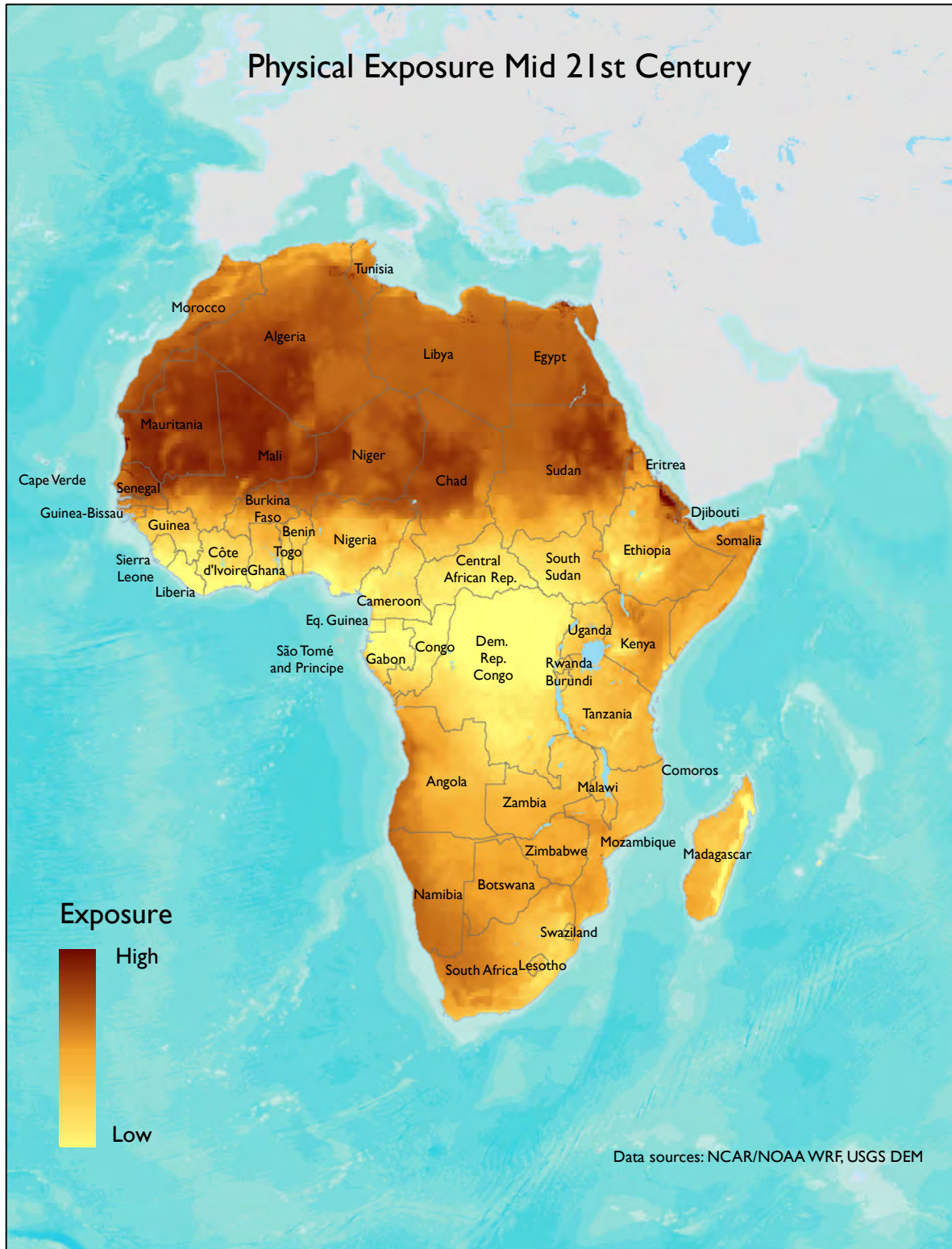


Figure 18



The composite maps based on this physical exposure basket are also subtly different. Since the only basket that changes is the physical one, the patterns between the late 20th simulation and the mid 21st century composite are similar. And, since the physical maps shows the relative vulnerability of places compared to all other places on the continent, these two composites don't change all that much, most notably in northern Mali which appears to become more vulnerable relative to other parts of the continent (see Figures 19 and 20).

Figure 19

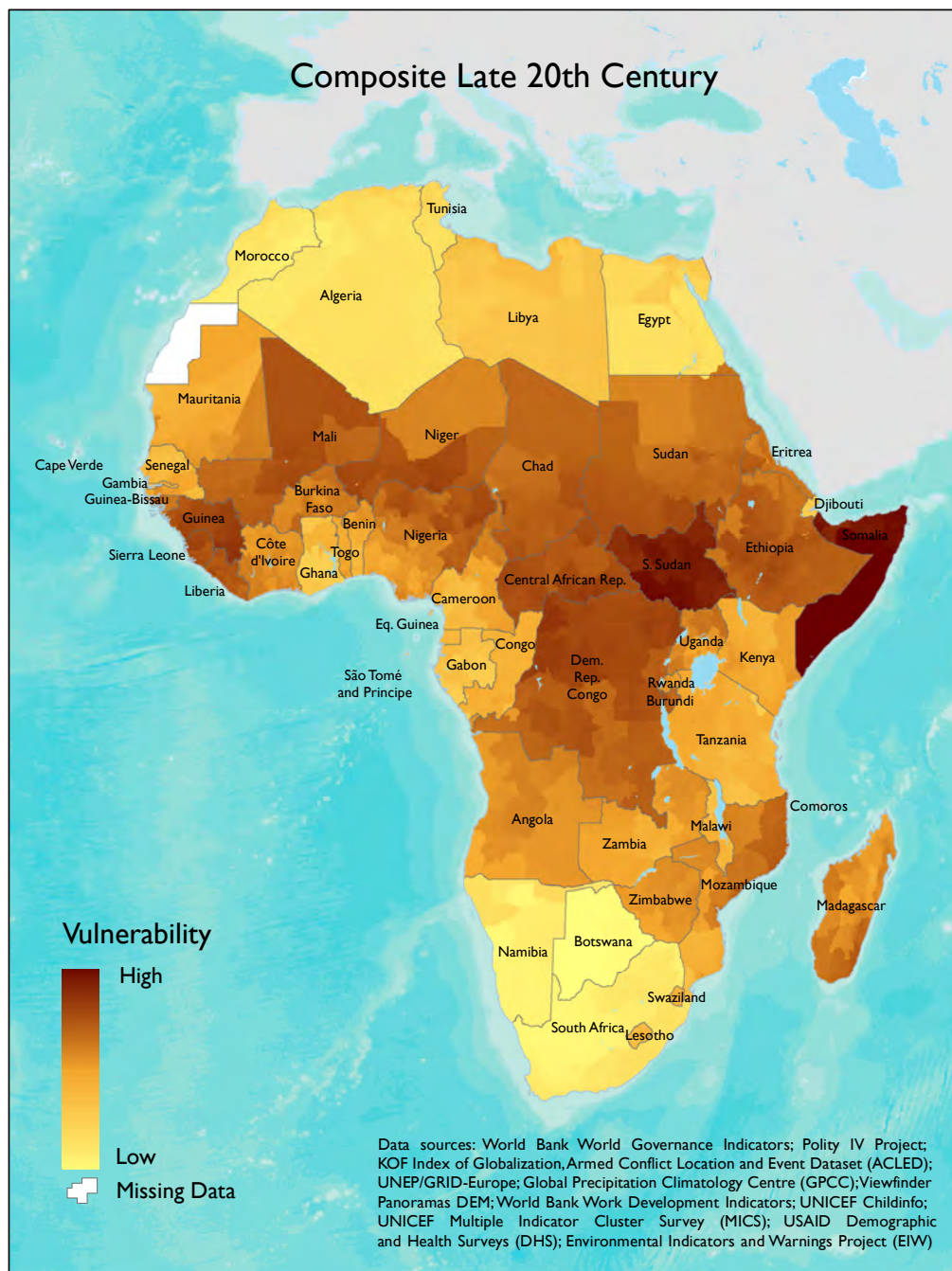
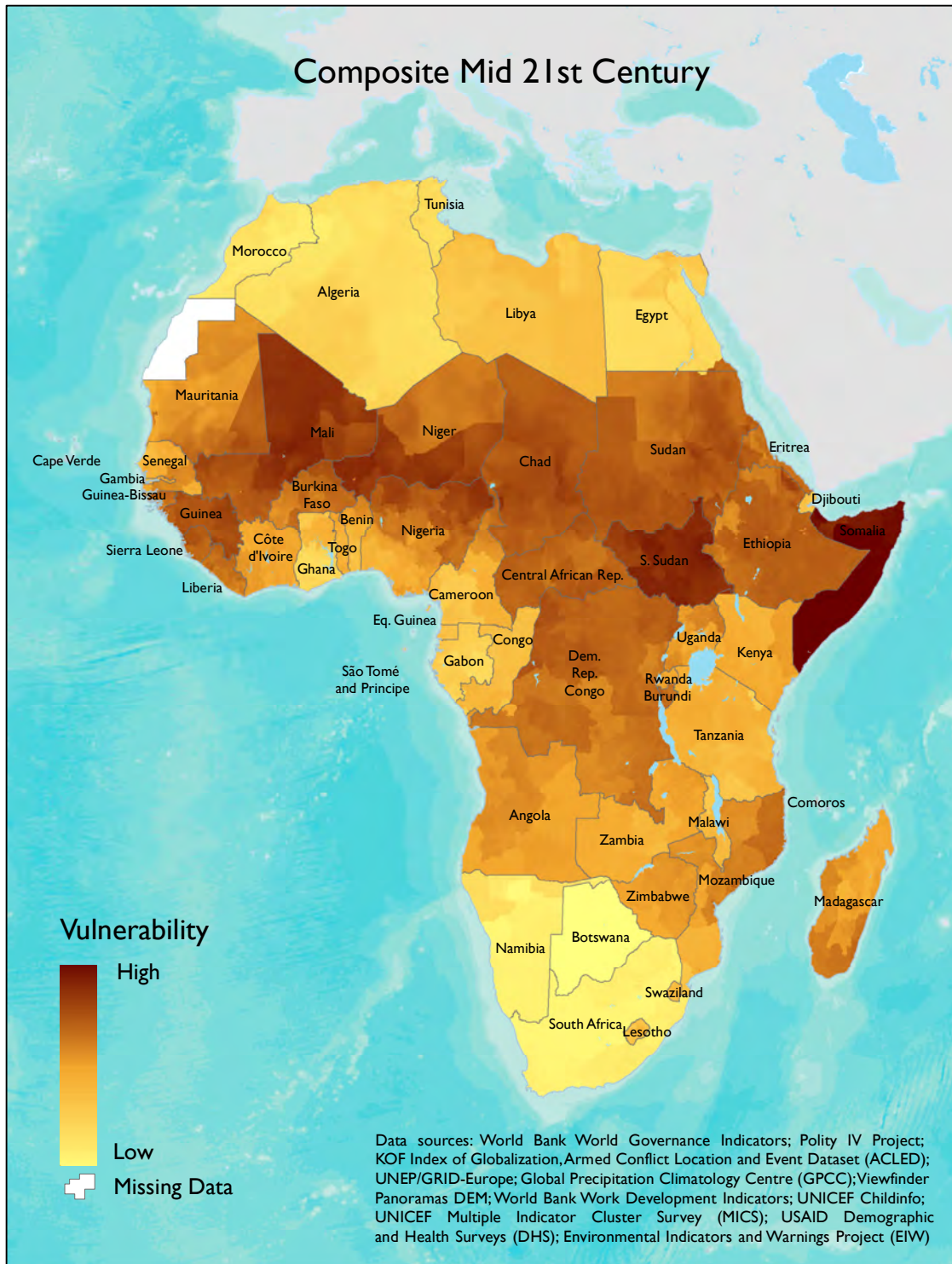


Figure 20



To be sure, 21st composite is not likely to depict what the distribution of vulnerability is like in 2050. Uneven changes in the distribution of populations, household resilience, and changes in governance will likely alter the complexion of the other three baskets. While other projects,

including Minerva projects have begun to project scenarios of national level conflict risk under different scenarios of future economic change, trying to do so at the sub-national level is a bridge too far given available methods.^{xxviii}

Applications of Results

The research team has applied its results and methodology to a number of different issues, including the intersection of ethnic power relations and climate vulnerability, U.S. strategic interests and vulnerability, foreign aid and vulnerability, and the causal connections between climate hazards and security outcomes in the case of Somalia.

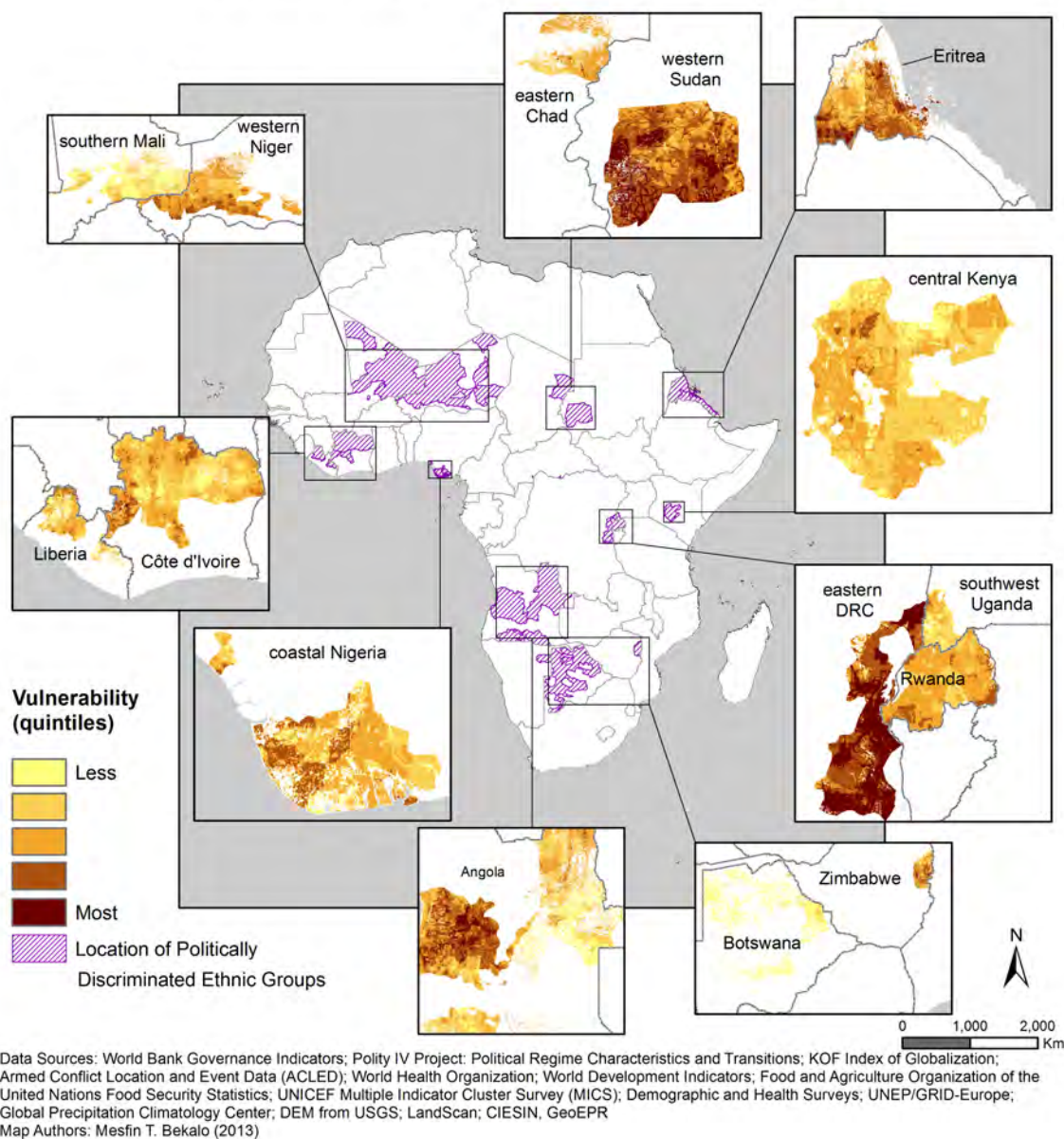
Ethnic Power Relations and Vulnerability

In an earlier iteration of the CSVSM published in *International Security*, the team used the georeferenced version of the Ethnic Power Relations dataset (GeoEPR) to identify the climate security vulnerability of different ethnic groups potentially ignored (irrelevant) by political elites or those unrepresented by ruling parties, either those politically powerless or those actively discriminated against by the government.^{xxix} This is a promising approach to identify places of concern where minority groups might be at risk in the event of a climate hazard because they are ignored or actively persecuted by the state in a time of need.

While the research team has updated the underlying vulnerability layer, the approach in a series of maps identified the vulnerability status of different ethnic groups, the irrelevant, the powerless, and the discriminated (see Figure 21 below for an example). In that iteration of the vulnerability maps, a number of countries and regions were home to discriminated groups including: Angola, Burundi, Kenya, the Democratic Republic of the Congo (DRC), Nigeria, Rwanda, Sudan, Zimbabwe, among others. In terms of overall composite vulnerability, the Fur people in western portion of Sudan and the Tutsi population in the eastern portion of the Democratic Republic of Congo both had a history of being discriminated against and were located in areas with high overall vulnerability in the iteration of the 2.0 iteration of the CCAPS vulnerability maps.^{xxx}

Figure 21

Vulnerability among *Politically Discriminated* Ethnic Groups in Africa (1990–2005)



Strategic Overlays

In an extension of the original project, the research team mapped the intersection of climate vulnerability with some proxies for U.S. strategic interests on the continent, including sites of oil fields, mineral sites, terrorism, piracy attacks, and embassies and consulates.^{xxxi}

A number of elements were selected to represent U.S. strategic interests selected the following as representative of U.S. national interests in Africa: access to key natural resources (e.g. oil,

minerals); violent extremist activity/terrorism (e.g. AQIM in Mali, Niger, Mauritania, and Algeria; Boko Haram in Nigeria; Al Shabaab in Somalia); piracy; and the presence of U.S. embassies and consulates.

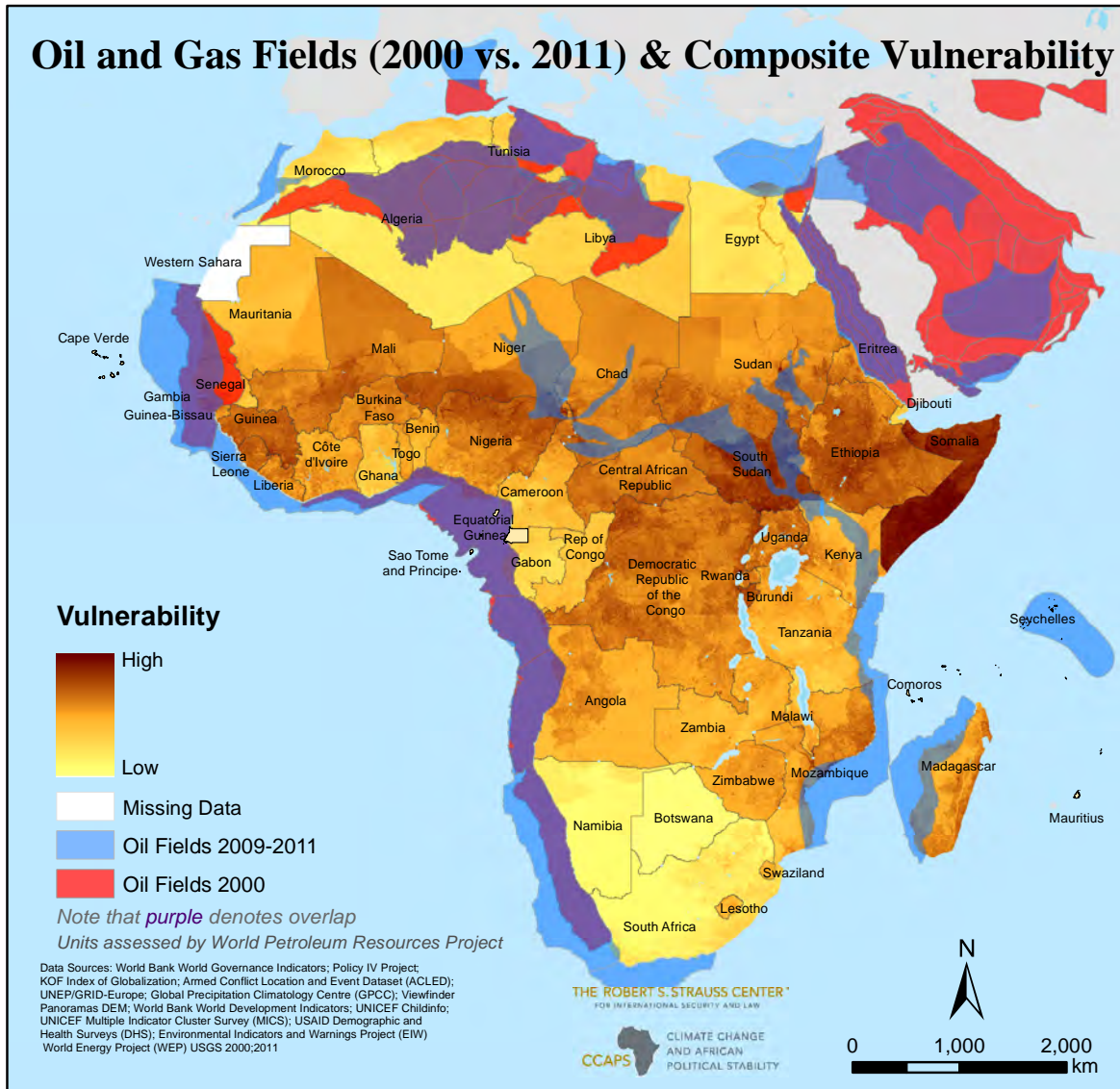
As a report from the Defense Science Board on climate and security indicated,^{xxxii} these include the core strategic interests that the U.S. government (or at least an important advisory body) regards as important, and for our purposes, they also can be represented spatially on a map. They also have more long-standing and higher salience as traditional grand strategic goals than elements such as democracy promotion or supporting strong market economies.

In terms of each of these dimensions, South Sudan and West Africa (off the coast of Guinea) are areas with oil fields and relatively high climate security vulnerability. In terms of mine sites, Africa does not have active rare earths but is the source of a number of other critical minerals. An illustrative set of minerals were mapped, but data visualization and data here require further development to be of much practical use. Somalia, South Sudan, and Nigeria all have been major sites of terrorism events and have some extensive areas of climate vulnerability. The Gulf of Aden off the coast of Somalia and the Gulf of Guinea Nigeria have been the main locations for piracy attacks, with Somalia showing high climate vulnerability. Finally, a number of embassies and consulates such as Maputo and Alexandria, Egypt are located in areas that are vulnerable to climate change, though other U.S. assets that have been important in field operations may be more useful to map in the future.

As noted, the team overlaid indicators of each of these interests on the subnational maps of climate security vulnerability. The data on raw materials focuses on oil and mine sites and are derived from a dataset from the U.S. Geological Service from 2001.^{xxxiii} The oil fields data was updated in 2011 (Figures 22 and 23).^{xxxiv}

The most notable sites of medium to high climate security vulnerability and oil and gas fields are coastal Nigeria, the border between Sudan and South Sudan in the disputed region of Abyei, Egypt at the mouth of the Nile, coastal Mozambique, and pockets in Chad.

Figure 22



In terms of mine sites, it is a bit more challenging to assess the importance of these disparate sites since not all minerals are equally important or lucrative. The research team elected to use minerals that were identified by the European Commission as “critical raw materials” including antimony, beryllium, cobalt, fluor spar, gallium, germanium, graphite, indium, magnesium, niobium, platinum group metals, rare earth elements, tantalum, and tungsten.^{xxxv} The World Minerals Statistical archive provided data on which African countries are major exporters of many of these minerals, with South Africa the most significant among them (Table 1).

Table 1: Critical Raw Materials and Major African Producers

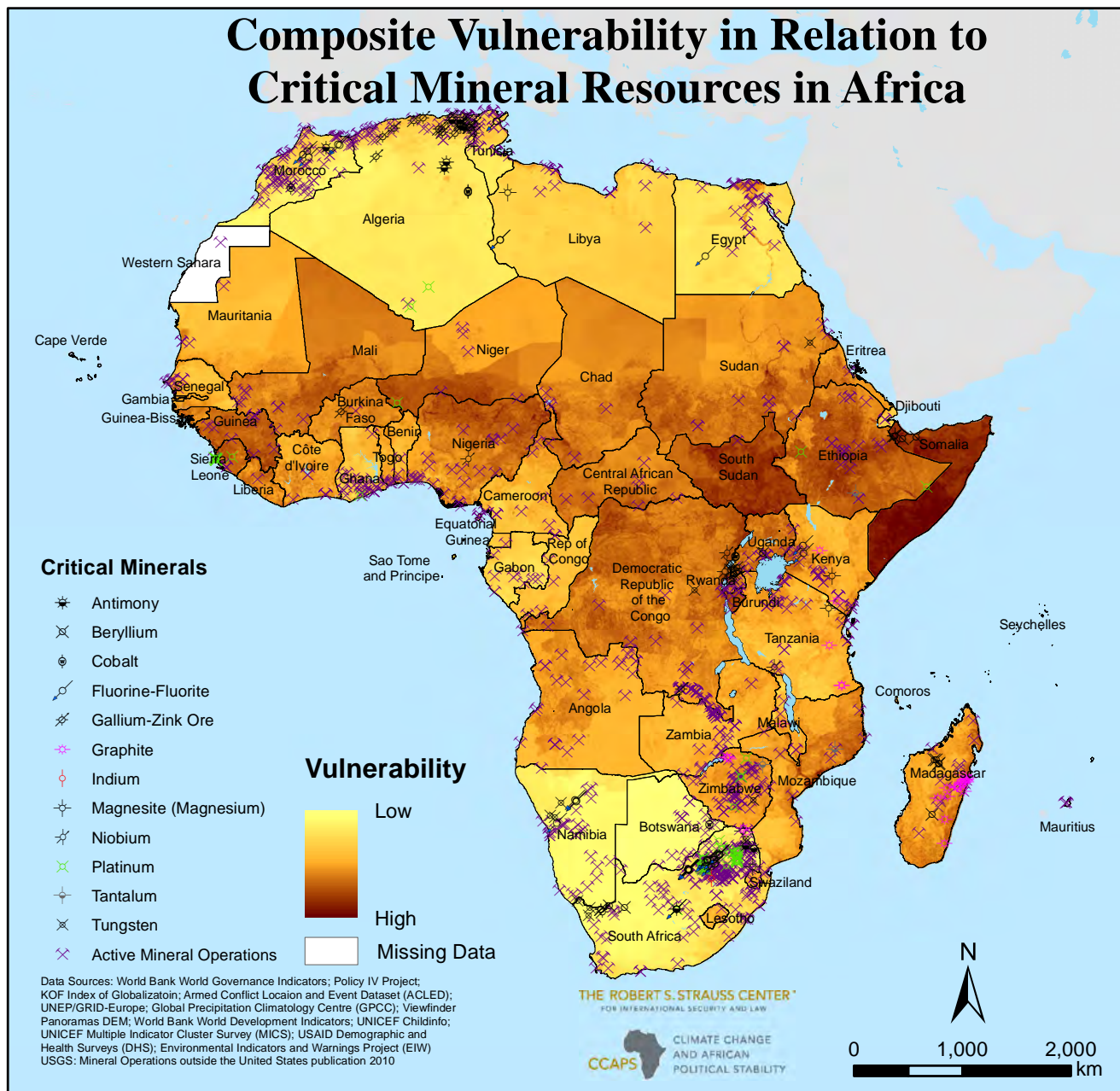
Critical Raw Material	Major African Producers (Share of Global Exports 2001-2011)^{xxxvi}
Antimony	No significant exports
Cobalt	Zambia 13%
Fluorspar	South Africa 14%
Graphite	No significant exports
Magnesium	South Africa .80%
Niobium	No exports
Platinum group metals	South Africa 39.86%
Tantalum	Nigeria 6.8%
Tungsten	South Africa 1.63%

The research team compared this data to geo-referenced mine site data from the USGS from 2001, which identified the mine sites for many if not all of these metals, with mine sites in and around South Africa as well as other lesser producers including North Africa, Madagascar, and the Great Lakes region (see Figure 22).

One might expect that climate change could have some affect on oil operations and mining, depending on the nature of the hazard. Cyclone-prone areas might face disruptions to their operations. Areas subject to storm surge similarly might experience periodic interruptions in site access and transshipment. Areas facing significant water anomalies might have limited water for industrial purposes.

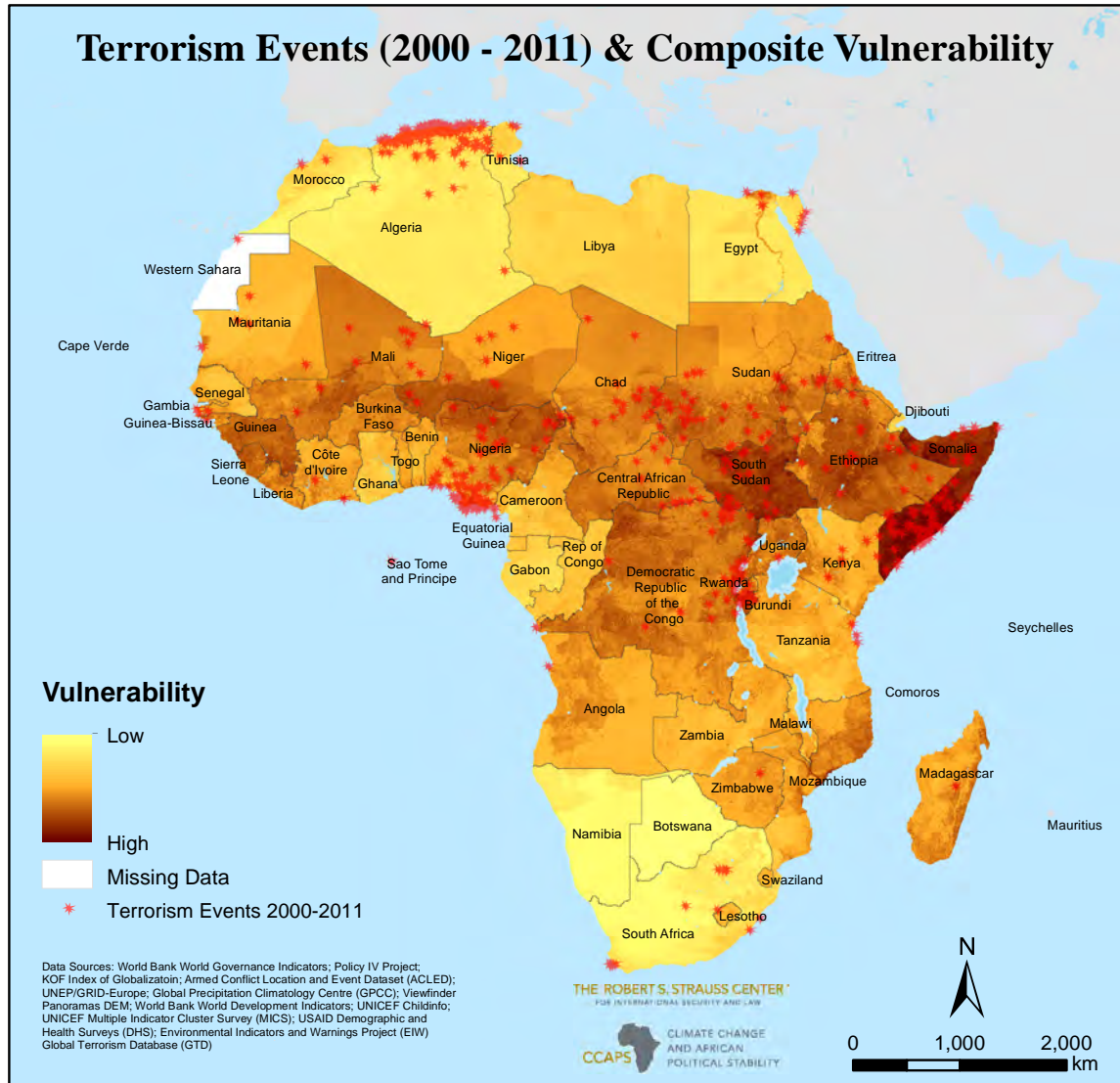
Here, the data are a bit dated and might not be representative of particular minerals of concern to the United States. More work at data visualization might be useful to clearly see the intersection of mine sites and climate security vulnerability. Nonetheless, the approach is suggestive of a useful way to think through the intersection of specific strategic interests and climate security vulnerability.

Figure 23



The data on terrorism includes terrorism events from 2000-2011 continent-wide from the Global Terrorism Database (GTD) (see Figure 24). The Global Terrorism database is one of the leading event data sources on terrorism events compiled by the University of Maryland.^{xxxvii} Geocoding was done in house by researchers affiliated with the CCAPS project.^{xxxviii} These are point data reflecting x,y coordinates, where available, for the cities or towns that were recorded as the site of terrorism events.

Figure 24



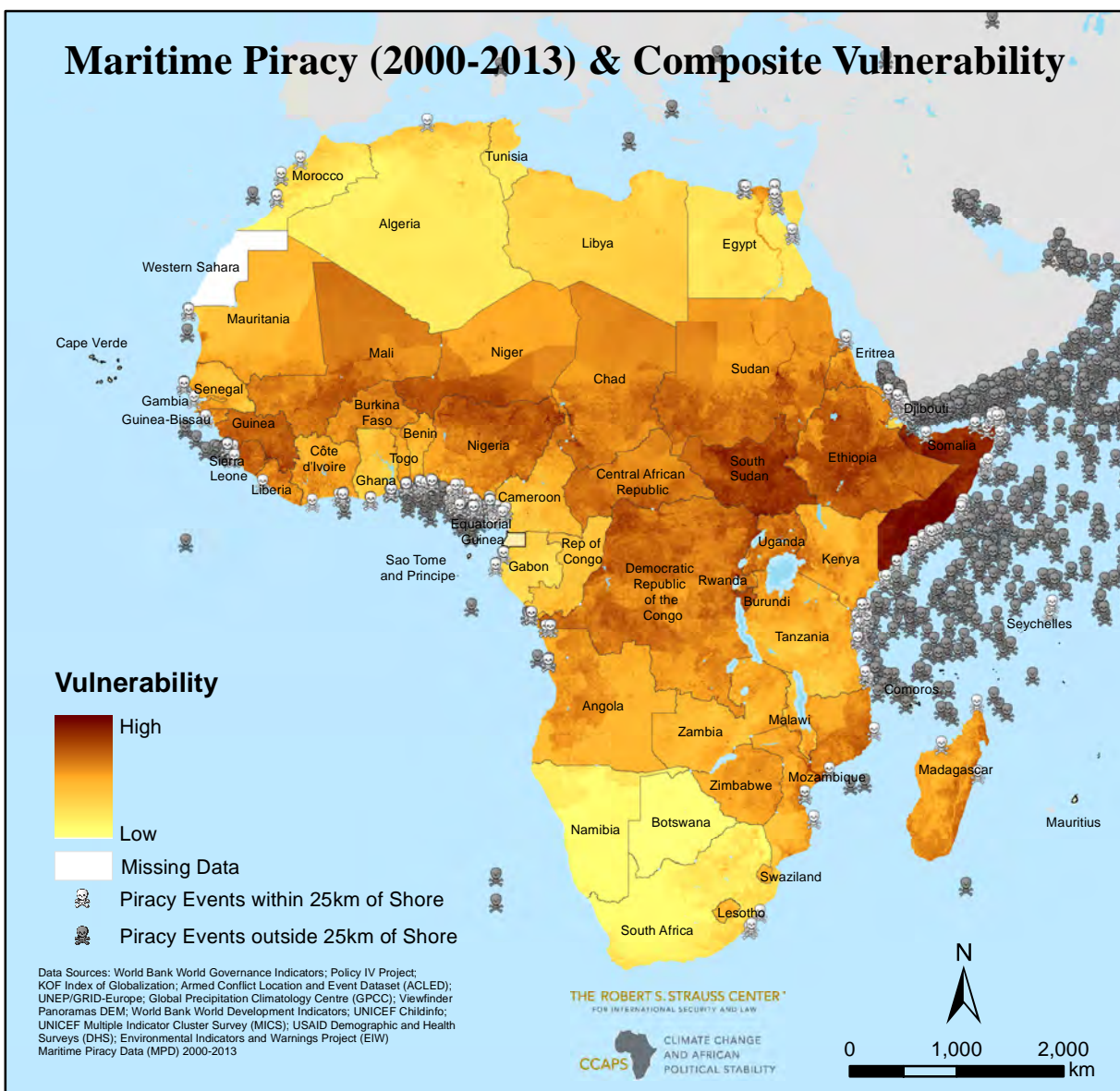
Among the areas registering high climate security vulnerability and a large number of event of terrorism were: (1) Somalia, (2) pockets in Nigeria (3) the Great Lakes region, and (5) Egypt with (6) high pockets in Niger. One of the challenges of evaluating this intersection is that the terrorism is highly correlated with indicator of armed conflict indicator already embedded in the climate security model. That conflict indicator is drawn from the Armed Conflict and Location Event Dataset (ACLED).

Since ACLED records attacks by rebel movements and terrorism may be a tactic employed by some of them, it is possible that there is some overlap in both measures. Moreover, it is not clear that the United States cares about all use of terrorism. Terrorism, as attacks against civilians, is a tactic used by a number of groups, not simply one deployed by ISIS and al-Qaeda. As a consequence, the United States might be more interested in specific actors deploying terrorism as a tactic.

It is unclear what it means to say that an area possesses both terrorism events and climate security vulnerability. Is the relationship causal: are we saying that climate change causes terrorism? Are these merely twin challenges that might beset an unlucky region? At this stage, given the potential overlap between conflict in index and terrorism as indicator in its own right, the most that can be said is that there are a few areas that are both vulnerable from a climate security perspective and have a history of experiencing terrorism. This theme is discussed in more detail in the conclusion.

The data on piracy reflects data from 2000-2013 as part of the Maritime Piracy Dataset (MPD). It was geocoded by Bridget Coggins using data from the International Maritime Bureau (see Figure 25).^{xxxix}

Figure 25

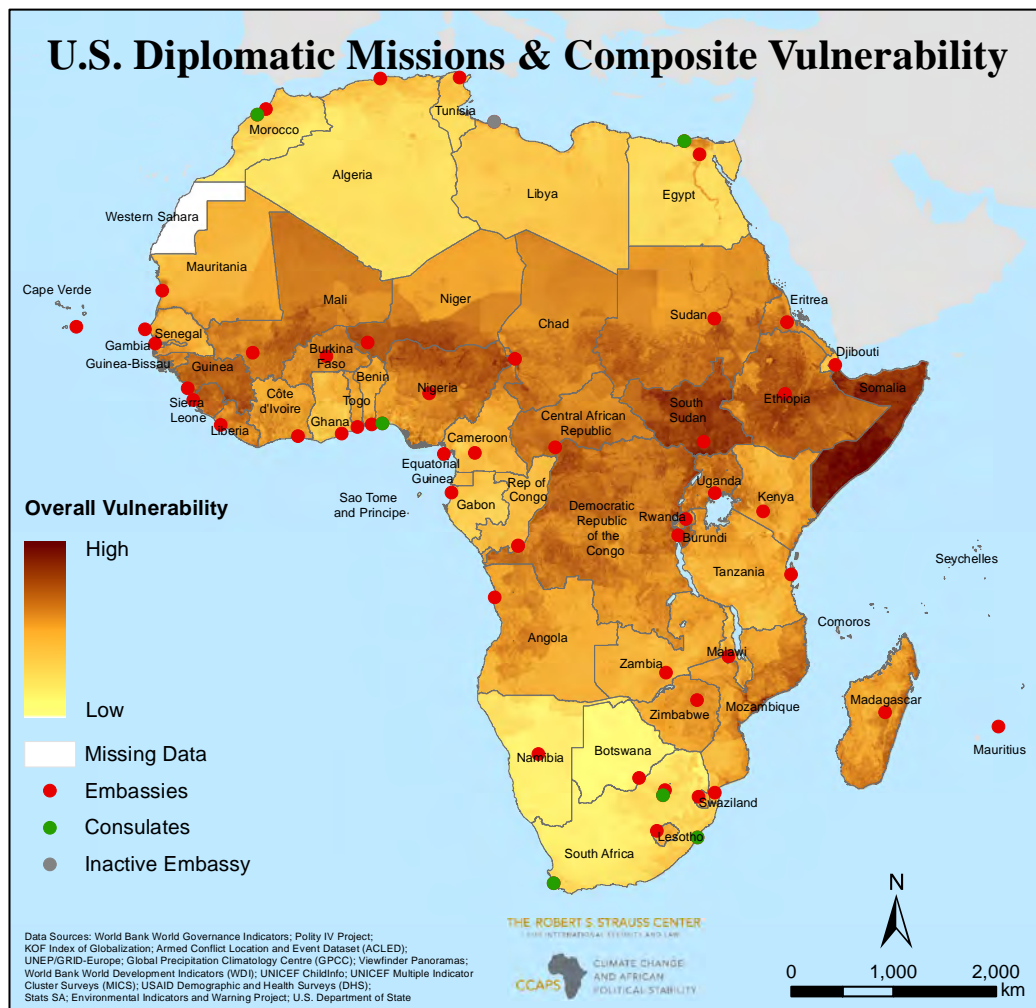


Here, in terms of areas of high climate security vulnerability, Somalia and the Gulf of Aden stands out as the region most affected by piracy over the past decade, followed by the Bights of Benin and Bonny off the coast of Nigeria. While these events increased dramatically over the decade, increased patrols by NATO ships coupled with increased arming of merchant ships led to a notable decrease of attacks in 2012.^{xl}

Again, what does it mean to say that an area possesses both high climate change vulnerability and problems with piracy? Some anecdotal evidence from Somalia has been offered to suggest that former fisherman engaged in piracy when fish yields declined as a response to changes in sea surface temperatures, though overfishing and exploitation by foreign fleets is more frequently offered as a “root cause” of people engaging in piracy behavior.^{xli}

Finally, data on U.S. embassies and consulates are derived from the U.S. State Department website (see Figure 26).^{xlii}

Figure 26



Among the areas of higher climate security vulnerability with a U.S. embassy or consulate presence nearby are Antananarivo, Madagascar and Maputo, Mozambique, both of which are subject to cyclones and flooding in poor countries with weak government capacity. Other locations of moderate to high climate security vulnerability and a near U.S. embassy presence are Abuja, Nigeria and Niamey, Niger, both subject to rainfall anomalies and flooding. Nouakchott, Mauritania and Alexandria, Egypt, which is subject to coastal storm surge and sea-level rise, are two other cities with a U.S. diplomatic presence. Other notable areas of climate vulnerability and a U.S. embassy presence include Addis Ababa, Ethiopia and the capitals of Great Lakes countries.

Perhaps most significant, the United States also re-opened its diplomatic mission in Somalia in fall 2016, which is not reflected yet on this map but is the country the features most strongly on our climate security vulnerability maps.^{xliii}

Here, we might imagine that the U.S. embassy might be called upon to assist the region in times of need. Individual facilities, particularly those subject to flooding and cyclones, might also be subject directly to the effects of climate change.

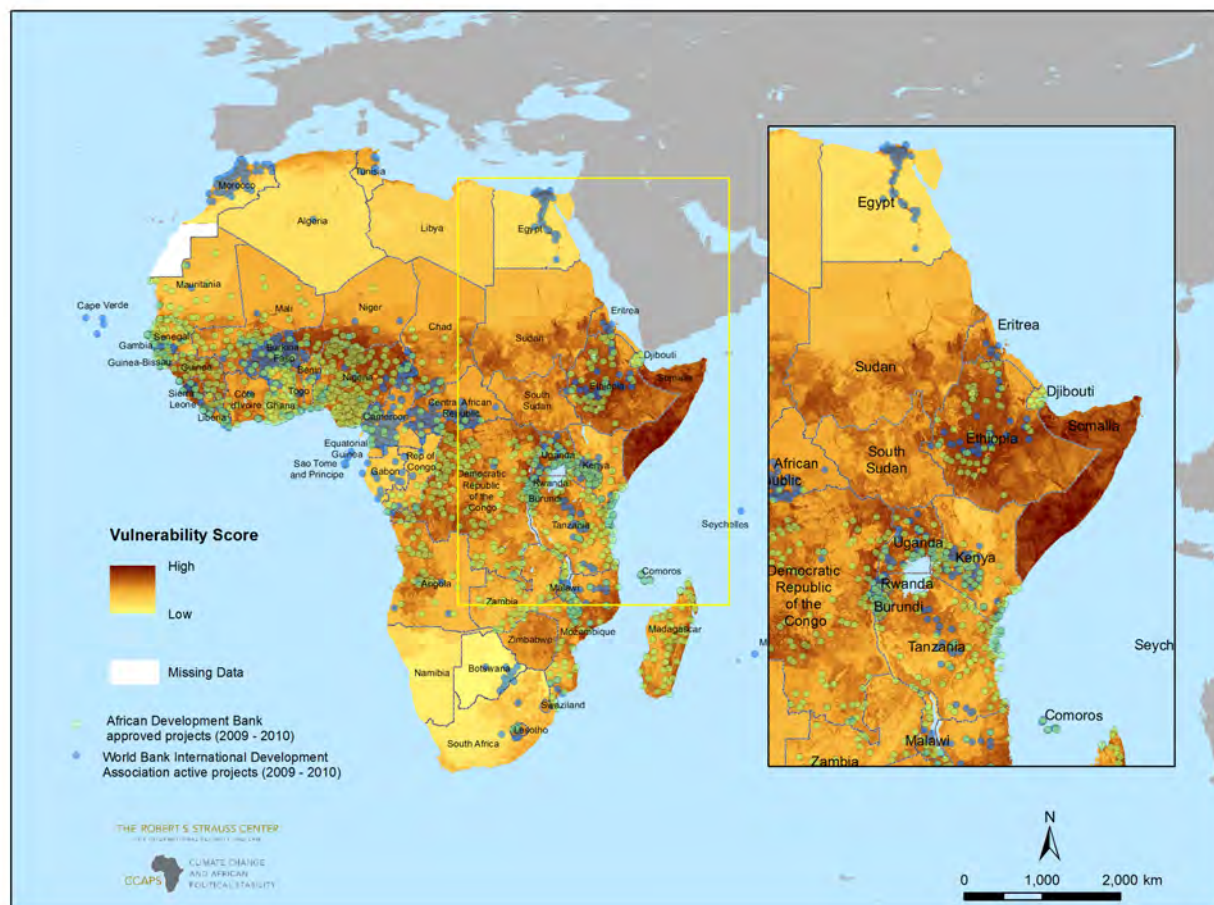
Other non-open source data on U.S. assets might be useful to overlay on the vulnerability layer. While Camp Lemonnier in Djibouti is a U.S. military base that is known to the world, the United States government is thought to use other locations as staging grounds for military operations. At the very least, some intersection of physical hazards with locations from where U.S. operations are staged could be useful to understand where climate hazards potentially may complicate military or humanitarian operations.^{xliv}

Aid Projects

As Catherine Weaver discusses in section 9, the vulnerable maps can also be compared with patterns of foreign aid projects to see if the places that are most vulnerable are the ones receiving foreign assistance. In an application for *Peace and Conflict 2014*, the team overlaid aid projects from 2009 and 2010 from the World Bank and African Development Bank on the vulnerability layer from the 3.0 iteration of the vulnerability maps.^{xlv}

As can be seen in Figure 27, Somalia registers widespread climate security vulnerability, but the absence of a functioning government made it nearly impossible for foreign donors to spend resources there.

Figure 27: World Bank and African Development Projects 2009-2010 and Climate Security Vulnerability



A Case Study of Somalia

What do these maps have to say about the causal connections between climate hazards and security outcomes including but not limited to conflict? Other pieces of the wider CCAPS project, namely the interventions in section 3 and 4 from Salehyan/Hendrix and Raleigh, speak to this more directly, but the issue merits some discussion here.

The quantitative political science community (along with a number of economists) has done important work to develop large N datasets to assess the correlations between climate hazards and internal conflict, including civil wars, lower level violence, and riots and strikes. The findings are somewhat contradictory, and a vigorous and contentious debate between different scholars has ensued.^{xlvi} Some of these conflicts are based on differences of opinion over model specification, data, and methodology.

In a return to some of the 1990s environmental security literature, perhaps what is now needed is more detailed process tracing of causal mechanisms connecting climate hazards with security outcomes.^{xlvii} This has not really happened in the field with the level of sophistication that is required.

While a number of studies have provided anecdotal evidence of prominent individual cases that seem to show a link between a climate hazard and a conflict outcome, many of these are potentially subject to the criticism that the authors are privileging the causal role of environmental concerns.^{xlviii} While some are more careful than others, the field still lacks an adequate understanding of the conditions under which climate hazards or shocks leads to security outcomes and the pathways that connect climate changes to violence or security concerns.

Somalia's particular vulnerability merits further study to ascertain whether climate-related factors are causally related to security outcomes. Until the rise of the Al Shabaab militia, the country was probably most known in the international community for the 1992 famine and the subsequent humanitarian/military mission that went awry in 1993 that were depicted in the book and film *Black Hawk Down*.

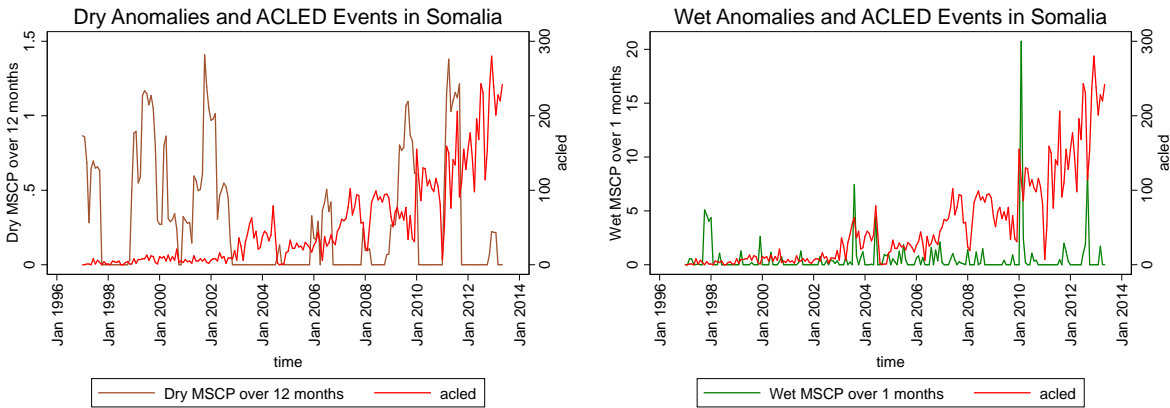
While the 1992 famine has obvious roots in a drought, not all severe droughts in Somalia have led to famine. Moreover, the connection to other security outcomes is worthy of further study. If climate changes lead to violence or humanitarian emergencies, then we should expect to see a climate signal precede the security outcome of concern. Even if this is found to be the case, this does not mean that the climate change necessarily drove the outcome or was the main causal factor. But, the absence of a climate signal preceding a security outcome would undermine the case of a climate cause.

The CCAPS vulnerability team made a preliminary assessment for Somalia in a 2013 paper for the American Political Science Association. Some of the analysis is summarized here.^{xlix}

The team used two weather anomalies, one to represent droughts (the twelve month accumulation of rainfall and how it compares to the previous twenty-years)^l and another to represent possible floods (the one month accumulation of rainfall and the comparison with the previous twenty year average for that same month). For Somalia (as well Mali and Nigeria), the team compared these dry and wet weather anomalies to terrorism events,^{li} piracy attacks,^{lii} ACLED conflict events,^{liii} and the EM-DAT database of disaster events.^{liv}

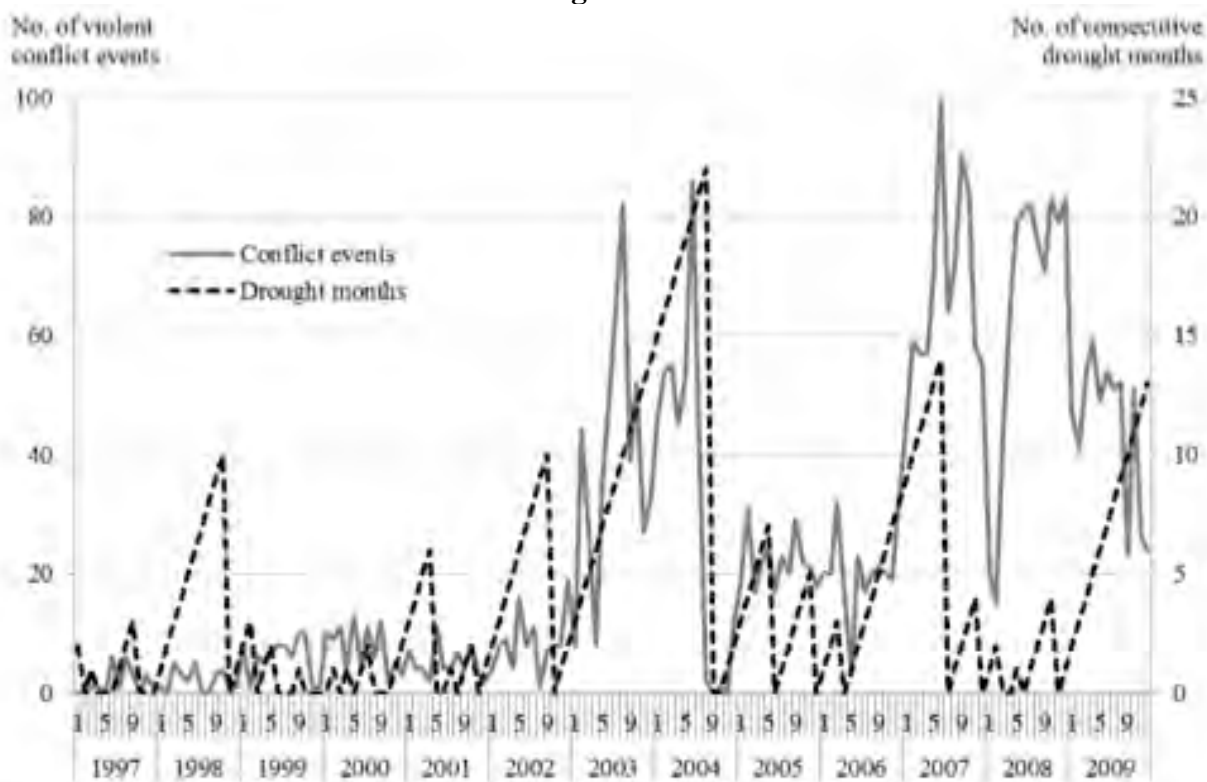
The team found few consistent and statistically significant correlations between the weather anomalies and the security outcomes. In Somalia, dry water anomalies and piracy attacks were consistently positively and significantly correlated but this was not true in the other focus countries or other security outcomes. Though individual years may show weather anomalies followed by sharp spikes or dips in security outcomes, Figure 28 charts the undulating rise in conflict events in Somalia from the early 2000s, despite fluctuation in weather anomalies.

Figure 28: Conflicts and Precipitation Anomalies in Somalia



The absence of a finding of a general relationship could be a function of modeling choices. Another study of Somalia by Maystadt et al. also used ACLED, but instead of rainfall, they used a measure of drought based on deviations in temperature, based on the logic that temperature more than precipitation explains temporal and spatial patterns of agricultural production in Africa. They find a more consistent pattern of drought followed by conflict (see Figure 27).^{lv} They buttress this with statistical work that finds droughts to be correlated with conflicts, with the mechanism through negative cattle price shocks (a result of destocking in lean times), with shocks to human well-being, in their view lowering the opportunity costs of engaging in conflict activity. The temperature-conflict association has been found in a number of publications,^{lvi} but the Maystadt piece is one of the first to try to unpack a causal mechanism. Whether their analysis or the CCAPS study has the right model specification is debatable.

Figure 29



Source: Authors' presentation based on ACLED 2011 and UEA-CRU 2011.

Note: See Section 3, "Methodology and Data," for the identification of drought months.

Source: Maystadt et al.

Despite the absence of general patterns in CCAPS research, there may be individual moments where environmental change indicators may be implicated in security outcomes.

Somalia has experienced a civil war continuously for more than two decades, starting with a coup in January 1991 that ousted the military dictatorship of Siad Barre. During that time, in addition to long periods of violence, Somalia has experienced two famines, the rise of the Islamist group Al Shabaab, and a major spike in offshore piracy events. Environmental factors thus could have played a role in all of these events, though for space considerations only some are reviewed here.

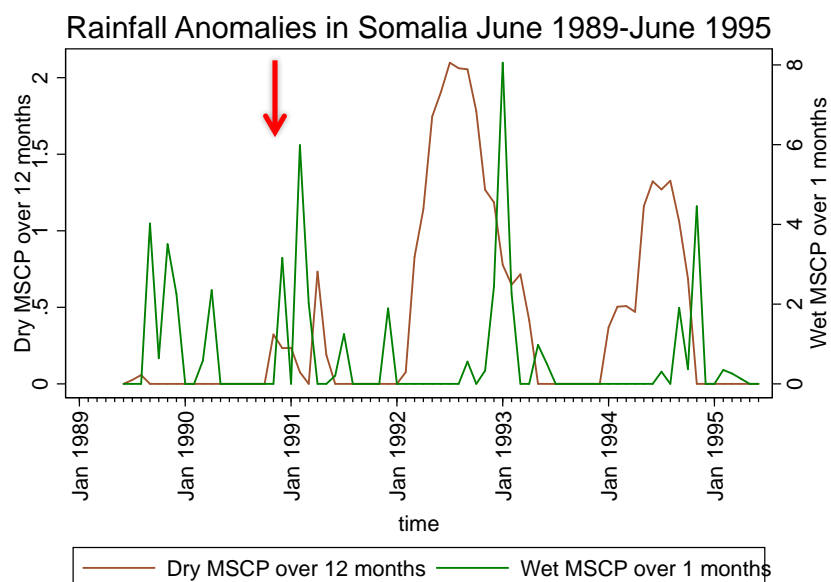
1991 Coup – Conflict Onset and Continuation

One of the purported mechanisms by which environmental hazards can affect security outcomes is through leader survival. Some scholars have found evidence that natural hazards may lead to leadership turnover, particularly through the effects on economic growth^{lvii} or in the wake of a leader's failure to respond to a disaster, triggering resentment by the populace.^{lviii} An alternative way to think about this event is in terms of conflict onset. Numerous studies have sought to assess how precipitation affects civil war onset with conflicting findings depending on model specification.^{lix}

Rainfall anomalies rather than scarcity per se are thought to be more relevant as a disruptive force that contributes to conflict, though the mechanism remains unclear. More abundant rains may induce conflicts by incentivizing raiding behavior, making it easier to hide in tall vegetation and providing more forage for healthier animals. More scarce rains than normal may make agricultural planning difficult, disrupting economic activity, and increasing the incentive to engage in anti-social violent activity.^{lx} None of these different explanations matter if no precipitation anomalies preceded the coup.

In January 1991, Somalia's military government was overthrown, leaving the country in permanent civil war and without a functioning central government for the next two decades. Shortly thereafter, Somalia was buffeted by a major drought in the first third of 1992 that, in the midst of the civil war, led to famine followed by a US-led United Nations humanitarian intervention. While that operation initially saved hundreds of thousands of lives,^{lxi} it ended with the infamous Black Hawk Down episode.^{lxii} However, as the red arrow in Figure 29 below demonstrates, the coup preceded the drought, and the period preceding the coup was not characterized by any major precipitation anomaly.

Figure 29

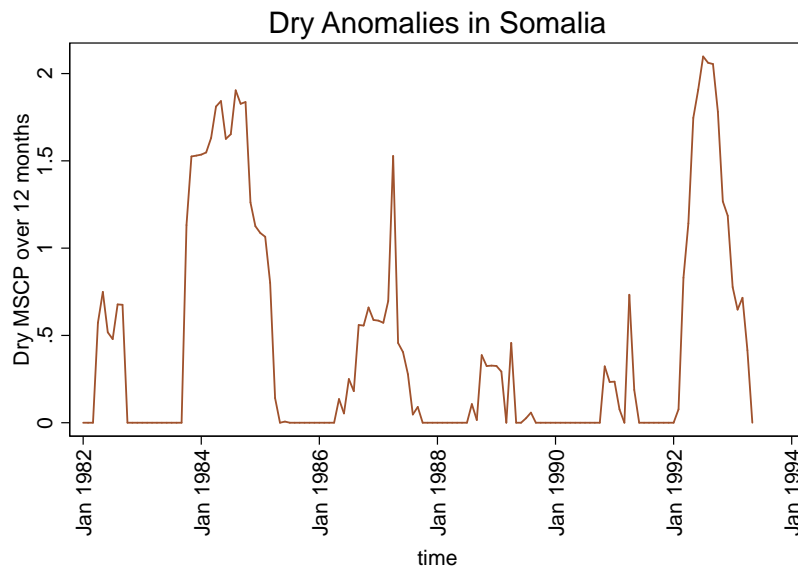


Data Source: Global Precipitation Climatology Centre

While that observation reflects that environmental change was not a trigger for conflict in Somalia, was it a background trend that potentially contributed to an environment ripe for violence in the preceding years, perhaps through agricultural production and economic growth?^{lxiii} As Figure 30 demonstrates, there were two significant rainfall anomalies in Somalia in the mid-1980s, one on par with the 2011 drought which produced a famine. Pastoralism, one of the main sources of livelihood in Somalia, was already in crisis in the 1980s because of overgrazing and large herd sizes, at a time when the country experienced some major dry periods.^{lxiv} The World Bank estimated that the value added Somalia's agricultural sector declined by 12% in 1983 when the drought period began, before recovering in 1984 and 1985 and then

fluctuating widely before exhibiting negative or slow growth in the two years prior to the coup.^{lxv} While in Somalia, this drought did not produce a major famine; in neighboring Ethiopia, it did, triggering the large-scale mobilization of Western aid through events such as Live Aid.

Figure 30



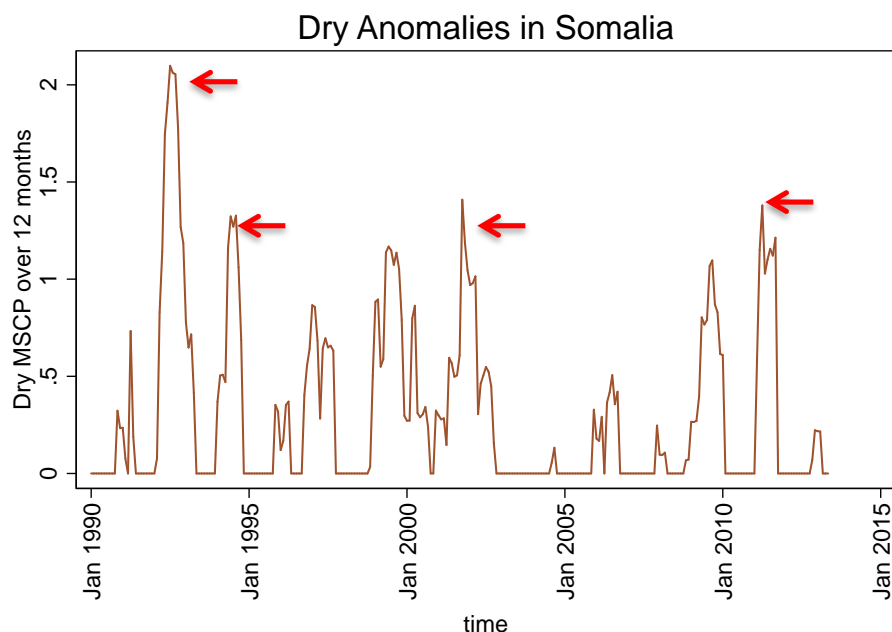
Data Source: Global Precipitation Climatology Centre

Thus, even if the immediate trigger of a drought in 1991 was not present, rainfall anomalies in the 1980s may well have helped undermine the Somali economy, providing additional conditions that made conflict more likely. By the same token, the 1992 drought could have also contributed to poor economic performance in the subsequent coup period, making conflict continuation more likely. As Figure 31 demonstrates, the period from 1994 to 2001 was punctuated by almost continuous dry rainfall anomalies.

Famines

Between 1990 and 2013, there have been four notable dry rainfall anomalies, two of which resulted were officially recognized as famines by the international community. The most severe rainfall anomaly occurred in 1992 (which led to famine), another occurred in late 1994, a third in late 2001, and a fourth in mid 2011 (which also led to famine).^{lxvi} As is clear from the rainfall anomalies, the 1994 (July), 2001 (October), and 2011 (July) droughts were similar in magnitude but only the 2011 drought led to famine.

Figure 31



Data Source: Global Precipitation Climatology Centre

Since only two of four severe dry periods led to famine, this suggests that environmental factors were necessary but not sufficient conditions for famine in Somalia. This within-case variation allows us to pursue the question: “Under what conditions do rainfall anomalies lead to famine?” Indeed, we can also make some comparisons between cases. As Ed Carr noted, the 2011 famine did not extend to Somalia’s neighbors in Ethiopia and Kenya even though they were experiencing similar environmental conditions.^{lxvii}

1992-1993 Famine

While the 1991 coup was not immediately preceded by a major precipitation anomaly, the 1992-1993 famine certainly was. As figure 31 indicated, this was the most significant dry anomaly of the last twenty years. By all accounts, the civil war made it difficult for farmers to sustain food production, disrupted markets, and made it difficult to mobilize a domestic response, putting millions at risk of famine. As Clarke and Herbst note, the cause of the famine was not simply a product of low rainfall: “The implication of those who support only humanitarian intervention is that Somalis were starving because of an act of nature. But the famine that gripped Somalia in 1992 resulted from the degeneration of the country's political system and economy.”^{lxviii}

The humanitarian emergency prompted a United Nations Mission Operation Provide Relief in August 1992 and then, when that failed, Operation Restore Hope in December 1992. Operation Restore Hope was a UN mission led by the United States and included some 25,000 out of a total of 37,000 troops.

Christian Webersik makes the case that political factors mattered more than the drought itself: “Rather, the devastation inflicted upon the interriverine population was rooted in their inability to defend themselves based on historical power relations.”^{lxix} Samatar makes a similar claim:

The epicentre of that famine was in Bay, one of the country's most productive agricultural regions, and starvation was induced by warlords who used food as a weapon against farmers and pastoralists. Marauding gangs had invaded the region after the collapse of the Somali state in 1991 and looted farmers' harvests. The country's major warlord wanted to capture the region, so did not allow food aid to reach the desperate population.^{lxx}

De Waal, drawing inspiration from Amartya Sen's work on the political roots of famine,^{lxxi} focuses on land "alienation" in the aftermath of the coup, "perhaps the single most important long-term reason for the famine."^{lxxii} While de Waal minimizes the role played by rainfall, we can see how exclusionary economic and political practices created a source of vulnerability. When the rains failed, those marginalized farmers that lacked access to irrigation were in grave danger.

2011 Famine

In 2011, much of southern and central Somalia was again buffeted by famine.^{lxxiii} In its aftermath, a UN commissioned study estimated the excess mortality that occurred between October 2010 and April 2012, the period of peak food insecurity and famine. That study estimated that some 258,000 excess deaths attributable to the emergency occurred during this period, 52% of them children five.^{lxxiv}

A variety of scholars and policymakers were quick to attribute the cause to climate change and environmental factors, from Jeffrey Sachs, USAID Administrator Rajiv Shah, the UN's David Orr, among others.^{lxxv} In response, some scholars disputed the role played by drought. Ed Carr, for example, focused on problems of food access and markets and a dysfunctional Somali state.^{lxxvi}

As our figure of water anomalies indicated, the 2011 drought was one of the four most severe droughts over the last twenty years, only exceeded by the 1992 drought, which also resulted in famine. FEWS NET for its part noted that rainfall during the *deyr* season in late 2010 was the lowest in fifty years.^{lxxvii}

Communities in eastern Ethiopia and northern Kenya did experience food insecurity during this period, albeit less severe than in Somalia, suggesting similar sources of exposure and vulnerability.

What was different in Ethiopia and Kenya? Both had successful relief operations, though with different roots. Ethiopia has a closed system and is more hostile to international agencies. Nonetheless, the Ethiopian has, in response to earlier failures in responding to droughts and climate hazards, developed a safety net with pre-positioned supplies.^{lxxviii} Both receive considerable international assistance for emergency relief, and by comparison with Somalia,^{lxxix} both were relatively more peaceful. For example, there were more than 1,400 ACLED events in Somalia in 2011, nearly 4 conflict events per day while there were only 162 in all of Kenya and 93 in Ethiopia.^{lxxx} As Maxwell et al. note, the violence in Somalia led to significant displacement and a loss of assets.^{lxxxi}

As many analysts noted at the time, the ongoing security situation complicated an emergency response, as the absence of a functioning state undermined local response and the al Shabaab limited both local and international delivery of aid relief as well as the movements of affected populations as they sought relief.^{lxxxii} Attempts by different local groups within Somalia to commandeer international aid is a long-running theme, extending back to the Siad Barre years, and this contestation was again prevalent in the lead up to the 2011 famine, complicated by the fact that the U.S. now had, in the post 9/11 era, legal prohibitions on distributing aid that could somehow benefit terrorist groups, with Al Shabaab having been formally listed in February 2008.^{lxxxiii}

The Non-Famines

What was different about 2011 compared to 1994 and 2001 when droughts of comparable magnitude did not lead to famine?^{lxxxiv} First, it is possible that the national level rainfall data presented here misses significant subnational and temporal variation such that the rainfall anomalies did not affect key food production areas in the same way or quite the same time as 2011. Second, the absence of a famine declaration in the other years does not mean the absence of major effects. For example, the EM-DAT International Disaster Database identifies twenty climate-related disaster events between 2002 and 2012, including five droughts and fifteen floods. Three droughts – one beginning in 2008, the famine of 2011, and a third in 2012 – affected an estimated 3.3 million, 4 million, and 3 million people respectively.^{lxxxv}

Leaving aside the question whether the drought events are truly comparable, an explanation might lie in the changed political landscape. While Somalia was buffeted by continuous statelessness throughout the post 1991 period, de Waal credits the country with having developed a resilient private sector that has thrived, particularly in areas where there was less insecurity like Somaliland and Puntland.^{lxxxvi} The situation began to deteriorate in the mid-2000s when the Union of Islamic Courts (UIC) seized control of much of southern Somalia in 2006, prompting a military intervention by neighboring Ethiopia, which antagonized Somalis and led to further radicalization of the UIC youth wing al Shabaab that emerged as an Islamist militia hostile to western intervention including aid donors.^{lxxxvii}

Al Shabaab and the deteriorating security situation made it increasingly difficult for international donors to remain in the country, including CARE which left in 2008. When the United States named al Shabaab a terrorist group in 2008, it made it impossible for the US to distribute aid in Somalia if it had the potential to benefit al Shabaab. As a consequence, US food aid to Somalia was cut off in 2009. The World Food Programme in early 2010 announced it could not meet its many obligations and withdrew from southern Somalia. Coupled with al Shabaab hostility to western aid agencies, these developments set the stage for too little too late response from the international community in 2011.^{lxxxviii}

Conclusions/Recommendations

CSVM 3.1 is a welcome advance over previous methodology, benefiting from updated data sources, expanded subnational data, and a refined methodology for calculating and depicting vulnerability. Some areas, namely over the Horn of Africa, show persistent vulnerability between iterations, and compare favorably with other data sources like EM-DAT.

However, there are differences between EM-DAT and CSVN as well as between the composite maps generated using physical exposure data from the regional climate model. This suggests the need for further methodological refinement going forward.

What does this research broadly and discussion specifically imply for U.S. policy? The co-location of climate vulnerability with strategic concerns most clearly constitute twin challenges for countries, with the causal connections between climate anomalies and security outcomes ambiguous based on the data and the more in-depth treatment of Somalia. Famine episodes are most clearly linked to anomalous dry weather, but environmental factors are not sufficient causes. On-going violence and patterns of political and economic exclusion can exacerbate the consequences of extreme weather, contributing to “complex emergencies” where, as Macias argues, often simultaneously possess “political violence, environmental disturbances, forced migration, and epidemic outbreaks.”^{lxxxix}

At the same time, external responses themselves may be problematic, if aid creates contestable resources for local actors or if outside actors impose their own interpretation of the situation without adequate grounding in local realities. Somalia, Nigeria, and Mali all represent cases where international actors including the United States have strong priors about the degree to which violent extremists in these countries are part of a broader threat. The challenge is that an undifferentiated approach to these challenges may be self-defeating. Scholars of all three cases have faulted U.S. and western policy for precisely this problem. Alex de Waal writes trenchantly of U.S. policy in Somalia:

For the West, Somalia is first and foremost a security problem, and the solution to it is to defeat the terrorists and let the politics follow. This approach has repeatedly backfired, antagonizing and radicalizing Somalis who have turned to Islam as a framework for rebuilding a moral order. Fundamentalists were struggling to gain a foothold in Somalia until foreign military interventions handed them the banner of nationalist resistance.^{xc}

Dowd and Raleigh make a similar point in reference to Mali. In their examination of AQIM in Mali and the Sahel, they contend that there is a tendency to see all terrorist groups as having global aspirations: “violent Islamist groups emerge in and are shaped by distinct domestic contexts and issues, a feature that is obscured by a totalizing narrative of global Islamic terrorism.” The Nigerian government appeared to be making such a mistake in their response to the rise of Boko Haram.

In his May 2013 counterterrorism speech, President Obama seemed to recognize the problem of uncritically lumping violent Islamist extremists under a universalist banner. He mooted that some groups employing terrorist tactics and having some al Qaeda affiliation may possess more local ambitions. As a consequence, he concluded: “Groups like AQAP must be dealt with, but in the years to come, not every collection of thugs that labels themselves al Qaeda will pose a credible threat to the United States.” Treating them as if they inherently pose a threat to the United States might mean “we may be drawn into more wars we don't need to fight.”^{xcii} Indeed, the United States has resisted labeling Boko Haram as a terrorist organization, as it would

reinforce the Nigerian government's militarized approach and leave little room for diplomacy.^{xcii} This more nuanced, context-specific approach may be important moving forward.

Efforts to identify the likely co-location of US strategic interests and climate security in Africa are merely the first step in helping concentrate the minds. In order to avoid the totalizing bias of treating these cases as requiring the same stock set of responses, deeper engagement about how these factors intersect and interact is required, including comparative work that allows policymakers to differentiate between cases.^{xciii} The data analysis and the deeper dive of Somalia presented here were meant to demonstrate what an even-handed effort might look like.

Thus, the process of mapping climate security vulnerability raises as many questions as it answers. The maps are meant to stimulate discussion about the priority areas in need of attention. The maps do not speak for themselves and are not the final word, requiring a more intense deliberation with regional experts. The stakes for getting this right are important, as resource allocation decisions for adaptation assistance and operational planning may one day be related to estimates of the relative vulnerability of different regions.

Appendix A. Indicators Used to Assess Physical Exposure to Climate Related Hazards				
Hazard Type (weight)	Indicator	Scale	Years of Data Used	Source
Cyclone Winds (20%)	Tropical cyclones average sum of wind speed (km per year)	2 km x 2 km resolution	1970-2009	UNEP/GRID-Europe
Floods (20%)	Flood Frequency (per 100 years)	1 km x 1 km resolution	1999-2007	UNEP/GRID-Europe
Wildfires (20%)	Number of Events	1 km x 1 km resolution	1995-2011	UNEP/GRID-Europe
Aridity (10%)	Monthly coefficient of variation	0.5 degree	1980-2009	Global Precipitation Climatology Centre
Rainfall scarcity (10%)	Number of months between 1980-2009 in which the 6-month accumulated rainfall was 1.5 standard deviations or more below the average for that calendar month over the previous 20 years	0.5 degree	1980-2009	Global Precipitation Climatology Centre
Inundation (Coastal elevation)	Low-lying coastal areas within 0 to 10km above sea level	3 arc second 1°x1° (90 m)		Viewfinder Panoramas

Appendix B. Indicators used to Assess Population				
Variable	Indicator	Scale	Years of Data Used	Source
Population Density	Ambient population (average over 24 hours)	Subnational at 1 km x 1 km resolution	2011	LandScan Oak Ridge National Laboratory

Appendix C. Indicators Used to Assess Household and Community Resilience				
Category (weight)	Indicator	Scale	Years of Data Used	Source
Education (25%)	Literacy rate, adult total (% of people ages 15 and above)	National, CCAPS First Administrative District	DHS 2003-2011, Stats SA 2011, World Development Indicators (WDI) 2006-2010	Subnational data from DHS, MICS, Stats SA; National data from WDI
	School enrollment, primary (% gross)	National, CCAPS First Administrative District	DHS 2003-2011, Stats SA 2011, MICS 2006-2010, UNICEF 2003-2008	Subnational data from DHS, MICS, Stats SA; National data from UNICEF
Health (25%)	Infant mortality rate adjusted to national 2000 UNICEF rate	CCAPS First Administrative District	2008	Environmental Indications and Warnings Project
	Life expectancy at birth (years) both sexes	National	2008, 2010, 2011	WDI
Daily Necessities (25%)	Percentage of children underweight (more than two standard deviations below the mean weight-for-age score of the NCHS/CDC/WHO international reference population)	National, CCAPS First Administrative District	DHS 1999-2010, WDI 2000, 2004-2008, 2011	Subnational data from DHS; National data from WDI
	Population with sustainable access to improved drinking water sources total (%)	National, CCAPS First Administrative District	DHS 2003, 2005-2011, MICS 2006-2007, 2010, Stats SA 2011, WDI 2001, 2006, 2008-2010	Subnational data from DHS, MICS, Stats SA; National data from WDI
Access to Healthcare (25%)	Health expenditure per capita (current US\$)	National	WDI 2001, 2010	WDI
	Delivery in a health facility (% of births)	National, CCAPS First Administrative District	DHS 1999-2008, 2010, UNICEF 2003-2008	Subnational data from DHS, UNICEF; National data from UNICEF

Appendix D. Indicators used to Assess Governance and Violence				
Category	Indicator (weight)	Scale	Years of Data Used	Source
Government Response Capacity	Government Effectiveness (20%)	National	2008, 2009, 2010, 2011, 2012	WDI
Government Responsiveness	Voice and Accountability (20%)	National	2008, 2009, 2010, 2011, 2012	WDI
Political Stability	Polity Variance (10%)	National	2002-2011	Polity IV Project
	Number of Stable Years (as of 2011) (10%)	National	1855-2011	Polity IV Project
Openness to External Assistance	Globalization Index (20%)	National	2011	KOF Index of Globalization
History of Violence	Subnational conflict events (20%)	CCAPS First Administrative Division	1997-2013	Armed Conflict Location and Events Database (ACLED)

ⁱ See Joshua W. Busby et al., “Advances in Mapping Climate Security Vulnerability in Africa” (Austin, Texas: Strauss Center for International Security and Law, April 18, 2013),

<http://www.strausscenter.org/ccaps/publications/research-briefs.html?download=153>.

ⁱⁱ Joshua W. Busby, Todd G. Smith, and Nisha Krishnan, “Climate Security Vulnerability in Africa Mapping 3.0,” *Political Geography*, Special Issue: Climate Change and Conflict, 43 (November 2014): 51–67, doi:10.1016/j.polgeo.2014.10.005.

ⁱⁱⁱ See <http://ccaps.developmentgateway.org/buildingthamodel>

^{iv} M. Boko et al., “Africa,” in *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. M.L. Parry et al. (Cambridge UK: Cambridge University Press, 2007), 433–67; IPCC, “Fourth Assessment Report -- Chapter 9: Africa,” 2007, <http://www.unep.org/pdf/ipcc/Ch09.pdf>; Reid Basher and Sálvano Briceño, “Climate and Disaster Risk Reduction in Africa,” in *Climate Change and Africa*, ed. Pak Sum Low (Cambridge: Cambridge University Press, 2005), 269–81.

^v Lisa Friedman, “Which Nations Are Most Vulnerable to Climate Change? The Daunting Politics of Choosing,” 2010, <http://www.nytimes.com/cwire/2011/02/24/24climatewire-which-nations-are-most-vulnerable-to-climate-95690.html?ref=energy-environment>.

^{vi} CCAPS has published versions of the Climate Security Vulnerability Model in a variety of outlets, beginning with in-house working papers and policy briefs; see Joshua Busby et al., *Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?* (Austin: Strauss Center for International Security and Law, 2010); and Joshua Busby, Kaiba White, and Todd G. Smith, *Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa* (Austin: Strauss Center for International Security and Law, 2011). The maps were then published in a series of papers and articles in journals and edited volumes, culminating in an article in the Spring 2013 issue of *International Security*; see Joshua Busby et al., “Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?,” in *Climate Change, Human Security and Violent Conflict*, ed. Jurgen Scheffran et al., Hexagon Series on Human and Environmental Security and Peace, 8 (New York: Springer, 2012), 463–512; Joshua W. Busby, Todd G. Smith, and Kaiba White, “Climate Security and East Africa: A GIS-Based Analysis of Vulnerability,” in *Climate Change, Pastoral Traditional Coping Mechanisms and Conflict in the Horn of Africa*, ed. Gebre Hiwot Mulugeta and Jean-Bosco Butera (Addis Ababa: University for Peace, 2012); Joshua W. Busby, Kaiba White, and Todd G. Smith, *Mapping Climate Change and Security in North Africa* (Washington: German Marshall Fund of the United States, 2010); and Joshua W. Busby et al., “Climate Change and Insecurity: Mapping Vulnerability in Africa,” *International Security* 37 (4) (2013). Newer iterations of the maps are available in Busby et

al., “Advances in Mapping Climate Security Vulnerability in Africa”; Busby, Smith, and Krishnan, “Climate Security Vulnerability in Africa Mapping 3.0”; Joshua Busby, Raleigh, Clionadh, and Idean Salehyan, “The Political Geography of Climate Vulnerability, Conflict, and Aid in Africa,” in *Peace and Conflict 2014*, ed. Paul K. Huth, Jonathan Wilkenfeld, and David A. Backer (Boulder: Routledge, 2014), 71–91.

^{vii} See www.fews.net/Pages/default.aspx.

^{viii} Maplecroft, for example, has produced a global climate vulnerability ranking at the subnational level; see Maplecroft, “Cities of Dhaka, Manila, Bangkok, Yangon and Jakarta Face Highest Climate Change Risks,” November 15, 2012, http://maplecroft.com/about/news/ccvi_2013.html. The Center for Global Development has produced a global vulnerability ranking at the national level; see David Wheeler, “Quantifying Vulnerability to Climate Change: Implications for Adaptation Assistance,” *Center for Global Development*, 2011, www.cgdev.org/content/publications/detail/1424759.

^{ix} In sensitivity tests, the assumption of equal weights was relaxed.

^x See www.gadm.org.

^{xi} The CCAPS team converted the percent rank to show where a given value is in percentage terms between the minimum and maximum score as represented by the equation $\text{minmax} = 1 - (\text{value} - \text{min}) / (\text{max} - \text{min})$.

^{xii} Percentile reflects the percentage of scores below a certain number. The equation representing percentiles is $\text{total number of values below } X / \text{total number of values}$.

^{xiii} For example, the research team prepared a multiplicative version of the model, whereby the climate hazard basket was multiplied by the addition of the other three baskets. In that model, zero to low climate exposure causes the composite score to approach one or no vulnerability.

^{xiv} The drought data are represented by a raster with values based on the six-month standardized precipitation index (SPI) according to the severity of drought in a given calendar year. If the SPI does not drop below -1 for at least three consecutive months, the value is set to zero. If the six-month SPI does drop below -1 for at least three consecutive months, the value is set to 1; if it is below -1.5 for at least two consecutive months, the value is set to 1.5. If both criteria are met, the value is set to 2.5.

^{xv} This is defined as the number of months between 1980–2009 in which the 6-month accumulated rainfall was 1.5 standard deviations or more below the average for that calendar month over the previous 20 years.

^{xvi} The coefficient of variation is the standard deviation divided by the mean. For areas with low mean rainfall values near zero (like deserts), the value for the coefficient of variation will approach infinity. Small deviations in rainfall will generate large changes in the coefficient of variation.

^{xvii} Global Climate Change Research Program (2011). Global Subnational Infant Mortality Rates ca. 2008. Environmental Indications and Warnings Project. Central Intelligence Agency. U.S. Government.

^{xviii} DHS administrative regional boundaries did not always correspond neatly to our level one administrative regions, with borders off slightly. In most cases, these were matched by using the centerpoint of CCAPS regions and applying the value from the DHS regions to CCAPS shapes. In the case of Burkina Faso and Rwanda, the differences between DHS regions and CCAPS shapes were more severe, with multiple DHS regions corresponding to one of the CCAPS regions. In such cases, a decision was made to apply a value to the CCAPS shape that was roughly representative of the DHS values for those regions (for example, if there were three values, the intermediate one was chosen).

^{xix} The team therefore chose to a diminishing weighted average with 2012 assigned the most weight (33.33%), followed by followed by 2011 (26.67%), 2010 (20%), 2009 (13.33%), 2008 (6.67%).

^{xx} The weighting function is as follows: $\text{gen wt_evnts} = \text{wgt_events} = \sum_{y=0}^{16} \frac{1+y}{17} \text{events}_{1997+y}$. This means that

events in 2013 gets a full weight of 1 but that diminishes by 1/17 each year until 1997 which gets a weight of only 1/17.

^{xxi} The other reason for using all level one administrative units is that the smaller the administrative unit that used, the fewer events, all else equal, that are likely to take place in a given unit. If a reasonably large level one administrative unit has many conflict events distributed across it, using a smaller administrative unit would then divide that larger pool of conflict events among the smaller units, making it appear that a country was less conflict-ridden relative to other geographic units.

^{xxii} For a disaster to be entered into the database, at least one of the following criteria must be fulfilled: ten or more people reported killed, one hundred or more people reported affected, a declaration of a state of emergency, or a call for international assistance. See www.emdat.be/criteria-and-definition.

^{xxiii} This included droughts, floods, storms, wet landslides, wildfires, and extreme temperatures. Centre For Research on the Epidemiology of Disasters (CRED), “EM-DAT: The OFDA/CRED International Disaster Database,” 2011, www.emdat.net.

^{xxiv} Special thanks to Madeline Clark for assisting with these efforts.

^{xxv} These results are discussed in Busby, Smith, and Krishnan, “Climate Security Vulnerability in Africa Mapping 3.0.” These maps are available in supplementary material online (\$) <http://www.sciencedirect.com/science/article/pii/S0962629814001012>

^{xxvi} These results are confirmed when one compares the mean resilience scores by administrative region with the number of EM-DAT events in that region or the percent rank of the number of events.

^{xxvii} Joshua W. Busby et al., “Identifying Hot Spots of Security Vulnerability Associated with Climate Change in Africa,” *Climatic Change* 124, no. 4 (2014): 717–31,

http://econpapers.repec.org/article/sprclimat/v_3a124_3ay_3a2014_3ai_3a4_3ap_3a717-731.htm.

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^{xxxvi} Natural Environment Research Council, “World Minerals Statistics,” *Minerals UK*, 2013, <http://www.bgs.ac.uk/mineralsuk/statistics/wms.cfc?method=searchWMS>. These are shares of quantities. The cobalt figure does not include ore and oxide exports. The platinum exports include kilograms of platinum, other platinum metals, platinum metals, and platinum & platinum metals, excluding Austria. The figure for tungsten just includes metals.

^{xxxvii} See <http://www.start.umd.edu/gtd>. GTD defines “The GTD defines a terrorist attack as the threatened or actual use of illegal force and violence by a non-state actor to attain a political, economic, religious, or social goal through fear, coercion, or intimidation.” To enter in to the database, an event requires intentionality, some threat to use violence, and perpetrators must be sub-national actors. In addition, two of three additional criteria had to be met: (1) some aims of political, economic, religious, or social goals, (2) intention to coerce, and/or (3) conduct outside legitimate wartime activities. National Consortium for the Study of Terrorism and Responses to Terrorism, “Global Terrorism Database - Codebook: Inclusion Criteria and Variables,” October 2012, 6, <http://www.start.umd.edu/gtd/downloads/Codebook.pdf>.

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^{xliv} Adam Taylor, "MAP: The U.S. Military Currently Has Troops in These African Countries," *Washington Post*, May 21, 2014, <https://www.washingtonpost.com/news/worldviews/wp/2014/05/21/map-the-u-s-currently-has-troops-in-these-african-countries/>.

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^{xlvi} The most vigorous proponents of the strong correlations between climate hazards and conflict are associated with Marshall Burke and Solomon Hsiang. The detractors of this perspective are associated with Nils Petter Gleditsch and Halvard Buhaug. Some articles that evaluate and summarize these debates include: Solomon M. Hsiang and K. C. Meng, "Reconciling Disagreement over Climate-Conflict Results in Africa," *Proceedings of the National Academy of Sciences* 111, no. 6 (February 11, 2014): 2100–2103, doi:10.1073/pnas.1316006111; Hsiang, Burke, and Miguel, "Quantifying the Influence of Climate on Human Conflict"; Solomon M. Hsiang, Kyle C. Meng, and Mark A. Cane, "Civil Conflicts Are Associated with the Global Climate," *Nature* 476, no. 7361 (print 2011): 438–41, doi:10.1038/nature10311; Burke et al., "Warming Increases the Risk of Civil War in Africa"; Halvard Buhaug, "Concealing Agreements over Climate–conflict Results," *Proceedings of the National Academy of Sciences* 111, no. 6 (February 11, 2014): E636–E636, doi:10.1073/pnas.1323773111; H. Buhaug et al., "One Effect to Rule Them All? A Comment on Climate and Conflict," *Climatic Change* 127, no. 3–4 (October 27, 2014): 391–97, doi:10.1007/s10584-014-1266-1; Nils Petter Gleditsch, "Whither the Weather? Climate Change and Conflict," *Journal of Peace Research* 49, no. 1 (January 1, 2012): 3–9, doi:10.1177/0022343311431288; Idean Salehyan, "Climate Change and Conflict: Making Sense of Disparate Findings," *Political Geography*, Special Issue: Climate Change and Conflict, 43 (November 2014): 1–5, doi:10.1016/j.polgeo.2014.10.004.

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^{xlviii} On Sudan and Darfur, see Thomas Homer-Dixon, "Cause and Effect," 2007, <http://blogs.ssrc.org/sudan/2007/08/02/cause-and-effect/>; Stephan Faris, "The Real Roots of Darfur," *The Atlantic Monthly*, 2007. On the Arab Spring and Syria, see Peter H. Gleick, "Water, Drought, Climate Change, and Conflict in Syria," *Weather, Climate, and Society* 6, no. 3 (March 3, 2014): 331–40, doi:10.1175/WCAS-D-13-00059.1; William R. Polk, "Your Labor Day Syria Reader, Part 2: William Polk," *The Atlantic*, September 2, 2013, <http://www.theatlantic.com/international/archive/2013/09/your-labor-day-syria-reader-part-2-william-polk/279255/>; Caitlin E. Werrell and Francesco Femia, eds., *The Arab Spring and Climate Change* (Washington, D.C.: Center for American Progress, Stimson Center, and the Center for Climate and Security, 2013), <http://www.americanprogress.org/issues/security/report/2013/02/28/54579/the-arab-spring-and-climate-change/>.

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^{lii} Piracy event data covers the period January 2000 - December 2011.

^{liii} ACLED events cover the period January 1997 - May 2013.

^{liv} EM-DAT events cover the period January 2002 - December 2012.

- ^{lv} Jean-Francois Maystadt, Olivier Ecker, and Arthur Mabiso, "Extreme Weather and Civil War in Somalia: Does Drought Fuel Conflict through Livestock Price Shocks?," LICOS Discussion Paper (LICOS - Centre for Institutions and Economic Performance, KU Leuven, 2013), 8, <http://ideas.repec.org/p/lic/licosd/32613.html>.
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Chapter 2. Future Climate Projections over Africa

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Executive Summary

Confident regional-scale climate change predictions for Africa are needed to support adaptation planning, and hence aid in the identification of security vulnerability associated with climate change over the continent. State-of-the-art regional climate model (RCM) simulations at 90-km and 30-km resolution are run and analyzed along with output from coupled atmosphere-ocean global circulation models (AOGCMs) from the Climate Model Intercomparison Project 3 (CMIP3) and Project 5 (CMIP5) to better understand how the climate will change over Africa during the 21st century. Four indicators deemed important for impacts analysis, namely heat wave days, number of dry days, number of extreme heavy rainfall days, and number of growing season days are examined and confidence in the projections is evaluated.

Projections indicate that there is a high likelihood for an increase in the number of heat wave days per year over Africa, with the largest increases predicted over the southern Sahara/Sahel. The number of heat wave days is also likely to increase south of the Sahel, extending into the Congo basin by the late-21st century. A significant decrease in the number of dry days is predicted over the Sahel and Horn of Africa, and an increase in the number of dry days is likely over southern Africa by the late-21st century. Extreme heavy rainfall days are predicted to increase over the Sahel and East Africa through the 21st century, consistent with the changes in the number of dry days. These changes however are not found to be significant at a high level of confidence (i.e., > 90 percent). Less certain is the projected decrease in extreme heavy rainfall days over southern Africa, as there is disagreement between the RCM and AOGCMs. Finally, RCM projections indicate that the number of growing season days is likely to increase over the Sahel by 10 to 25 days at mid-century and 20 to 40 days at late century, and decrease over much of southern Africa by 10 to 40 days at mid-century and by more than 50 days at late-century.

Introduction

Climate change affects society and our surrounding environment in a broad variety of ways. Associated changes in rainfall and temperature patterns are expected to have a profound effect on human welfare including health, agriculture, and bio-diversity. The continent of Africa is thought to be particularly susceptible to climate change given a high vulnerability to climate variability and relatively low adaptive capacity. Thus, it is crucial to improve our understanding and ability to predict climate change and its impacts at the regional spatial scales needed to allow for better adaptation planning to help mitigate impacts unfavorable to humanity including security vulnerability associated with climate change.

Project Purpose

The purpose of this research initiative is to provide state-of-the-art future climate projections over Africa during this century due to increased atmospheric CO₂, accompanied by an evaluation of confidence in the projections. The evaluation provided below focuses on indicators important for impacts analysis including extreme events (e.g., heat wave days, dry days and intense rainfall) and changes in the growing season. Regional climate model (RCM) simulations are analyzed along with output from coupled atmosphere-ocean global circulation models (AOGCMs) from the Climate Model Intercomparison Project 3 (CMIP3) and Project 5 (CMIP5) prepared in advance of the Intergovernmental Panel on Climate Change's Fourth and Fifth Assessment reports, IPCC AR4 and IPCC AR5 respectively. Both types of models are used to take advantage of the strengths of each. Regional model simulations provide finer resolution needed for resolving intense rainfall events and topography, and offer information on space scales that are relevant for regional impacts analysis and planning. AOGCMs, on the other hand, provide global connectivity.

Study Design/Approach

Two phases of RCM simulations were conducted. Both phases involved using the National Center for Atmospheric Research/ National Oceanic and Atmospheric Administration (NCAR/NOAA) Weather Research and Forecasting (WRF) regional model V3.1.1.¹

Phase 1 RCM simulations

For phase 1, two ensembles of six annual 90-km resolution RCM simulations are run and analyzed on the large domain shown in Figure 1. The first ensemble, P1-L20C, is representative of conditions during the late 20th century (1981-2000). These simulations are run in climate-mode^{2,3,4,5} meaning that the initial, lateral, and surface boundary conditions for all six ensemble members are derived from the 1981 to 2000 monthly climatology in the National Centers for Environmental Prediction reanalysis 2, NCEP2.⁶ These boundary conditions include seasonality, but shorter timescales are filtered out. The six ensemble members are year-long simulations with different initial conditions.⁷

The second ensemble, P1-M21C, represents mid-21st c. (2041 to 2060) conditions under the IPCC AR4 A1B emissions scenario. A1B is a mid-line scenario for balancing carbon dioxide output and economic growth. The atmospheric CO₂ concentration is increased to 536 ppmv, the 2041 to 2060 average in the A1B scenario. Effects of other greenhouse gases and aerosols are not included. Boundary conditions for the P1-M21C simulations are derived from nine CMIP3 coupled AOGCM simulations and applied as anomalies to the reanalysis boundary conditions. These future AOGCM anomalies are calculated as differences between monthly-mean, A1B-forced simulations averaged over 2041 to 2060 and historical simulations averaged over 1981 to 2000 and added to the reanalysis climatological monthly averages. Finally, 6-hourly values for the P1-M21C simulations are derived using linear interpolation. Soil moisture initialization values from P1-L20C are used for the P1-M21C simulations, and six ensemble members are generated as for the P1-L20C case. For a complete description of the experimental design of the Phase 1 simulations please see the referenced literature.^{7,8}

Phase 2 RCM simulations

The RCM experimental design for Phase 2 is updated from Phase 1 in order to improve the regional prediction capabilities over Africa.⁹ The first change is to include in 90-km mother domain a one-way nested 30-km horizontal resolution domain centered over Africa to better resolve regional scale processes. The placement of this domain is denoted by the red box shown in Figure 1. Another adjustment is to run each simulation using synoptic boundary conditions as opposed to climatological conditions and to run for more years, in this case 20 years as opposed to six years. These changes are needed to improve the model's predictive capabilities at mid-latitudes (i.e., over southeastern Africa) and to provide a longer temporal record to calculate statistics and significance, especially related to extreme weather events. A third change from Phase 1 is to utilize the IPCC AR5 CMIP5 AOGCMs to derive the future initial and lateral boundary condition anomalies needed to force the future RCM simulations.

As part of Phase 2 three 20-yr integrations are run. The first simulation is a control, P2-CTL, and represents conditions for 1989 to 2008. Initial, lateral, SSTs, and surface boundary conditions are derived from the 6-hourly NCEP2. The atmospheric CO₂ concentration is held fixed at 367 ppmv which is the 1989 to 2008 20-yr average observed at the Mauna Loa Observatory.

The second integration, P2-MID21, represents mid-21st c. (2041 to 2060) conditions under the IPCC AR5 RCP8.5 scenario. This is a business-as-usual scenario with the largest greenhouse gas emission increases out of the four IPCC AR5 scenarios. The atmospheric CO₂ concentration is increased to 546 ppmv, the 2041 to 2060 average for the RCP8.5 scenario. Effects of other aerosols and greenhouse gases besides water vapor are not included. Boundary conditions for the P2-MID21 simulation are derived from CMIP5 AOGCM simulations and applied as anomalies to the reanalysis boundary conditions used to force the CTL.

The final integration represents conditions at the end of the 21st c. (2081 to 2100) and is referred to as P2-LATE21. The atmospheric CO₂ concentration is increased to the 2081 to 2100 average value of 850 ppmv from the RCP8.5 scenario. Initial and lateral boundary conditions are derived in the same manner as they were for P2-MID21, but from using the RCP8.5 CMIP5 AOGCM anomalies averaged over 2081 to 2100. P2-LATE21 is initialized on 00Z 15 March 2080 and was intended to run through 00Z 1 January 2101 using the same number of vertical levels (32) and top of the atmosphere setting (20 hPa) as the P2-CTL and P2-MID21. However, the 30-km simulation began to develop model instabilities and crashed shortly after completing 2089. At this point the 30-km domain was deactivated yielding only nine years of integration to analyze at this resolution. A similar problem occurred for the 90-km domain after year 2092, but the remaining eight years of the P2-LATE21 90-km domain simulation are generated by running the model with the top of the atmosphere adjusted to 10 hPa.

Results

Results from the above-mentioned research initiative simulations are highlighted below. For more detailed information please see the associated publications.^{7,8,9,10}

Phase 1 Results

The quality of the PI-L20C simulation is first evaluated to assess the model's ability to realistically simulate the annual cycle over Africa.⁷ A reasonable representation of the climate is viewed as a necessary but not sufficient condition for a confident prediction.

Figure 2 shows a comparison of seasonal rainfall over Africa between the high-resolution NASA TRMM 3B42V6 rainfall product and the RCM model for December to February (DJF), March to May (MAM), June to August (JJA), and September to November (SON). The RCM realistically simulates the migration of the rainfall distribution over the annual cycle with the heaviest rains occurring over southeastern Africa in DJF, over the equatorial Congo basin in MAM and SON, and over the Sahel and tropical northern Africa in JJA. While the spatial distribution is realistic, the RCM tends to overestimate the intensity of the precipitation rates in the wettest areas. This is most evident over southeastern Africa during DJF (Figure 2b), and the over tropical northern Africa in JJA (Figure 2f).

Figure 3 shows an evaluation of the seasonal surface air-temperatures and 850 hPa low-level winds between the ERA-Interim reanalysis (1989 to 2009) and P1-L20C simulation. Generally, the RCM captures the seasonal structure of the temperature fields and the low-level flow reasonably well with seasonally dependent warm temperature biases including over sub-Saharan Africa in DJF (Figure 3b), over East Africa in MAM (Figure 3d) and JJA (Figure 3f), and over southern Africa in SON.

While the simulation of the present day climate is not perfect, the RCM demonstrates that is capable of producing a state-of-the-art simulation of the African climate, including seasonal changes, and hence can be a useful tool to understand how the climate is projected to change due to global warming.

Next, the analysis focuses on identifying and developing climate measures most important for impacts analysis and evaluating how they are projected to change in the future. Four such measures are discussed below. Other measures are discussed in publications associated with this work.^{7,8}

The first measure is *heat wave days*. Predicting heat waves is important because they are often associated with mortality statistics, yet there is no universally-adapted definition of a heat wave.¹¹ The methodology employed by the U.S. National Weather Service (NWS) is followed and heat waves are defined based on the exceedance of a fixed apparent temperature value that represents a lower physiological limit threshold. Apparent temperature factors in temperature, relative humidity, and wind speed to identify extreme days that are of concern for human health. Here, a heat wave is defined when the daily maximum apparent temperature is greater than or equal to 41°C for at least three consecutive days. The threshold of 41°C represents the point when heat cramps and heat exhaustion are likely, with heat stroke probable with continued activity. A duration of at least three consecutive days is chosen based on evidence that mortality is more likely by the third day under such conditions.¹²

Figure 4 shows an evaluation of how well P1-L20C simulates the number of heat wave days per year compared to two different reanalyses, namely the NCEP2 (Figure 4a) and ERA-Interim

(Figure 4b), as well as how the number of heat wave days are projected to change during the mid-21st century (Figure 4d). A comparison of the two reanalysis estimates indicates the uncertainty of how many heat wave days are likely to occur over the Sahara, with heat waves being more spatially confined in the NCEP2 reanalysis. The NCEP2 reanalysis tends to have a cold bias over the Sahara, which may explain the limited number of heat wave days in Figure 4a compared to Figure 4b. The distribution of the P1-L20C estimates (Figure 4c) compares favorably to the ERA-Interim, with the greatest number of heat wave days simulated over northeastern Sudan, the Bodélé region of Chad, southwestern Niger/northern Burkina Faso, and northern Senegal/southern Mauritania. Generally, the number of days predicted by the RCM for the above-mentioned maxima is 5 to 10 days greater than the number observed from the ERA-I reanalysis. By mid-21st century (Figure 4d), the average number of heat wave days is projected to increase over much of northern Africa, with the largest increase occurring over the western Sahel from Senegal to Niger. There is also a projected increase in the number of heat wave days south of the equator over Mozambique and Malawi.

The second measure evaluated is the *number of dry days* per year. Here, a dry day is defined when the daily rainfall rate is less than 1 mm, and the days need not be consecutive, since the experimental design of Phase 1 does not allow for the evaluation of dry periods that extend for multiple years.

Figure 5 shows the average number of dry days per year from the satellite-derived GPCP (Figure 5a) and TRMM (Figure 5b) climatologies to compare with the P1-L20C simulation average (Figure 5c). The overall spatial distribution is realistic, but the RCM does not simulate as many dry days as in the observations so the agreement with the GPCP data is better than with TRMM. The RCM captures the minimum over the Congo basin, but somewhat too strongly. Over southeastern Africa the RCM tends to simulate too few dry days. However, the regional model results represent an improvement over the IPCC AR4 AOGCMs.

Figure 5d shows the P1-M21C projected difference in the number of dry days, while Figure 5e shows this change expressed as a percent change from P1-L20C. By mid-century there is a projected decrease in the number of dry days over much of interior Africa north of the equator, ranging from 5 to 20 days over Niger, northern Nigeria, Chad, Sudan, and the Central African Republic, to 15 to 35 days over the Congo basin. Over East Africa, much of southern Africa south of 10°S, and western West Africa the number of dry days increases.

Another measure evaluated is the *number of extreme wet days* per year. This measure uses the 95th percentile of wet days to define a threshold value that if exceeded, defines whether a day is an extreme wet day.^{13,14} Here a wet day is any day that when the daily rainfall is greater than 1 mm. Associated with this measure is the *extreme wet day rainfall intensity*, which is the average daily rainfall rate of the extreme wet days identified. It is determined by dividing the annual accumulated daily rainfall associated with extreme wet days by the number of extreme wet days. Figure 6 shows the number of extreme rainfall days (Figures 6a-c) and the average rainfall intensity of extreme rainfall days (Figures 6d-f) for the observed GPCP and TRMM satellite-derived rainfall climatologies and the P1-L20C simulation. P1-L20C produces a distribution of the numbers of extreme rainfall days over sub-Saharan northern Africa that is similar to the observations, though the RCM tends to predict 2 to 8 more extreme wet days than observed

along the Guinean Coast and over the Congo basin (Figures 6a-c). In terms of average rainfall intensity of extreme wet rainfall days (Figures 6d-f), the spatial patterns are generally similar over most regions, but the magnitudes can differ considerably with the RCM generally falling within the observational range. The exception to this is along the Somalia, Kenyan and Tanzania coastline where the simulated intensity is much lower than the observed range reflecting the dry model bias over this region. South of the equator over southeastern Africa, the RCM predicts 6 to 8 more extreme rainfall days with generally heavier rainfall than estimated from the observations.

Figures 7a and 7b show the projected P1-M21C difference in the number of extreme wet rainfall days per year and the percent change, respectively, while Figures 7c and 7d show the projected changes in the average intensity of extreme wet rainfall days expressed as an amount and a percentage, respectively. The number of extreme wet days increases by 40 to 60 percent (4 to 8 days) over West Africa south of 10°N, by at least 50 percent (1 to 5 days) over the central and eastern Sahel, by 50 to 90 percent (3 to 7 days) over the Ethiopian highlands, and by 50 to 100 percent (1 to 4 days) over southern Somalia, Kenya, and Tanzania. The number of extreme wet days decreases by 30 to 60 percent (3 to 6 days) over the northern Congo basin, Central African Republic, northern Cameroon, and southern Sudan. The differences in extreme wet day rainfall intensity vary regionally and are spatially complex. The most coherent signals include a 30 to 70 percent decrease in intensity over southern Niger and northeastern Mali, a 10 to 25 percent increase in intensity over Senegal, southern Mali, Burkina Faso, northern Nigeria, and southern Chad, and a 25 to 75 percent increase over the Horn of Africa. Over southernmost Democratic Republic of Congo, Zambia, and eastern Angola the number of extreme wet days is projected to decrease by 25 to 75 percent (2 to 8 days) associated with a general reduction in extreme wet day rainfall intensity.

Given Africa's reliance on rain-fed agricultural practices another important measure to evaluate is the number of *growing season days*. While there are a variety of different techniques to estimate the African growing season length from climate information,¹⁵⁻²⁰ here the methodology developed by the Food and Agriculture Organization (FAO) of the United Nations that uses the precipitation and potential evapotranspiration to estimate the growing season length is adopted.^{7,21}

Figure 8a shows the calculated growing season days from the FAO/NRC, while Figure 8b shows the same estimate from the P1-L20C simulation. The overall pattern of the growing season day distribution is reproduced by the model with maxima over the Congo basin, Ethiopian highlands, and along the Guinean Coast. The RCM simulates the pronounced meridional gradient over the Sahel, albeit 2 to 4° of latitude further south. The one location where the RCM does a relatively poor job is over southeastern Africa, where the number of growing season days is too large. Closer examination indicates this deficiency is associated with unrealistic simulation of rainfall during the austral winter months that yields an unobserved second, short growing season produced by the RCM.⁷

Figure 9 shows the P1-M21C projected changes in growing season days over Africa expressed as the number of days (Figure 9a), and as a percent change from the number of days in P1-L20C (Figure 9b). Significant coherent regional signals are projected and include up to a 30 percent

increase in growing season days over the central and eastern Sahel, and marked decreases greater than 60 percent over the Greater Horn of Africa, Angola, and Zambia.

Phase 2 Results

The high-resolution Phase 2 simulations are analyzed in a similar fashion as the Phase 1 results discussed in the previous section. Furthermore, a multi-model assessment approach is utilized, comparing the RCM projections to those produced by the CMIP5 RCP8.5 AOGCMs when possible. Agreement among different models supports confidence because it suggests that the results are not highly dependent on the details of parameterizations that can differ from one model to the next.

Figure 10 shows the ensemble average number of *heat wave days* per year from the 30-km (Figure 10a) and 90-km (Figure 10b) resolution P2-CTL simulations. The spatial distribution of the number of heat wave days are consistent with the ERA-Interim (Figure 4b) and P1-L20C simulation results (Figure 4b), with the most heat wave days located over the western Sahara of Algeria, Mauritania, Mali, over the Bodélé of Chad, and northeastern Sudan. Compared to Phase 1 (Figure 4c), the magnitudes are in better agreement with ERA-Interim for these simulations. Increased spatial resolution appears to better focus the relative maxima within the topographic depressions.

The projected mid-21st century (i.e., 2041 to 2060) changes in the number of heat wave days for the 30-km and 90-km resolution P2-MID21 simulation are shown in Figures 11a and 11b, respectively. These simulations indicate a significant increase in the number of heat wave days over much of northern Africa, consistent with the Phase 1 projections. By the late-21st century (Figures 11c and d) the increase in heat wave days becomes even more pronounced with the largest increases occurring over the Sahel/southern Sahara region. Heat wave days are also likely to become a greater concern over southern Africa including over Mozambique, Botswana, Namibia, and southernmost Zambia and Angola.

The number of *dry days* per year from the P2-CTL RCM simulations and CMIP5 AOGCM historical experiments are evaluated in Figure 12 against the observational GPCP (Figure 12a) and TRMM 3B42V7 (Figure 12b) climatologies. The RCM (Figures 12c-d) does realistically capture the distribution. The Congo basin wet bias is still present in the RCM, but there is improvement over the Phase 1 RCM simulations (Figure 5c) and most of the CMIP5 historical experiment AOGCM simulations evaluated (Figures 12e-h). While still not perfect, there is also a considerable improvement in the P2-CTL simulation of the number of dry days over Mozambique, Zimbabwe, Zambia, and Botswana compared to Phase 1.

Taylor diagrams showing the spatially variability of the mean annual frequency of the number of dry days per year are shown in Figure 13 to better quantify the performance of the RCM relative to the observations and other models. These diagrams are calculated for the analysis region shown in Figure 12. This analysis indicates that regardless of the reference dataset utilized, the RCM's performance in simulating the distribution of the number of dry days over this area is as good if not better than the best AOGCM. Furthermore, increasing the resolution of the RCM

from 90-km to 30-km mainly improves the root mean square difference and slightly lowers the standard deviation.

The projected mid-21st century changes for the RCM and CMIP5 RCP 8.5 AOGCMs is shown in Figure 14. The most significant differences emerge across the Sahel where there is a projected 5 to 15 day decrease in the number of dry days, and over the Zambia and Angola where there is a projected 10 to 20 day increase by the RCM (Figures 14a-b). While not as spatially robust as the RCM response, the AOGCMs (Figures 14c-f) do suggest the increased likelihood for a reduction in dry days across the Sahel. The AOGCMs are in better agreement regarding the increase in the number of dry days over southern Africa, though the AOGCM response is generally more widespread compared to the RCM and is found to be highly significant (i.e., at the 99 percent level of confidence) in only half of AOGCMs analyzed.

By the late-21st century (Figure 15) the projected changes at mid-century become more prominent, including for the AOGCMs. All of the models indicate a decrease in the number of dry days across the Sahel with the exact location and the magnitude of the decrease model dependent. Furthermore, the increase in dry days over southern Africa is statistically significant in all of the models analyzed. Finally, the RCM and AOGCMs suggest a significant decrease in the number of dry days over the Horn of Africa.

Figure 16 shows an evaluation of the *number extreme heavy rainfall days* per year for the RCM, CMIP5 AGCMs, and CMIP5 AOGCMs. The RCM simulations (Figures 16c-d), while not perfect, closely simulate the observed spatial distributions, and are more similar to the GPCP distribution than the TRMM 3B42V6 distribution. The NCAR CCSM4, CNRM-CM5, and MIROC5 AGCMs (Figures 16e-g) tend to overestimate the number of extreme heavy rainfall days almost everywhere including over the tropics between 15°S and 10°N, while the MRI-CGCM3 yields a realistic distribution. For a more thorough evaluation please see the associated publication.²² This overestimation of extreme heavy rainfall days is generally greater in the fully coupled AOGCM simulations (Figures 16i-l).

Figure 17 shows a Taylor diagram for the number of extreme heavy rainfall days per year, comparing the RCM and CMIP5 AGCMs/AOGCMs to each other relative to the TRMM 3B42V6 reference dataset. Generally, the RCM is as skillful as the best CMIP5 AOGCM, the MRI-CGCM3, and increasing the model resolution from 90-km to 30-km only marginally improves the root mean square error and lowers the standard deviation.

The mid-21st century RCM projections (Figures 18a-b) project an increase in the number of extreme heavy rainfall days across the Sahel and over much of East Africa (e.g., Ethiopia, Kenya, and Tanzania). South of 10°S there is no coherent signal emerging. Note these differences are not found to be statistically significant at the 90 percent level, but are consistent with the P1-M21C projections (Figure 7). The most noticeable difference between P1-M21C and P2-MID21 occurs over the Congo basin, where P1-M21C predicts a more widespread decrease in the number of extreme heavy events, while the predicted decrease is more isolated and not found to be significant in P2-MID21.

The CMIP5 RCP8.5 AOGCMs analyzed (Figures 18c-g) are in general agreement with the increase in extreme heavy rainfall days over East Africa, while only three of the AOGCMs (Figures 18c, e, and f) project an increase over the Sahel. The two AOGCMs that simulate little or no change over the Sahel (Figures 18d, g) have difficulties simulating the present day boreal summer northward migration of the primary rainfall band from the Guinean Coast to the Sahel in the historical simulation, which likely contributes to the disagreement in the future projections. Over the Congo basin the AOGCMs predict an increase in extreme heavy rainfall days, unlike the RCM. However, as shown in Figures 12 and 16, this is one region where the AOGCMs have great difficulty in simulating the spatial characteristics and distribution of rainfall. Again the changes in extreme heavy rainfall days over sub-Saharan Africa are not found to be significant at the 90 percent confidence interval for the AOGCMs.

The late-21st century projected RCM changes in the number of extreme heavy rainfall days (Figures 19a-b) are consistent with the simulated mid-21st century changes with an increase in extreme heavy rainfall days over the Sahel and East Africa. Furthermore, the projected decrease in the number of days over Angola and Zambia is now more spatially coherent. Widespread areas of statistically significant changes emerge in the 90-km resolution RCM projections, but remain isolated still in the 30-km resolution projections. Again there is good agreement with the AOGCMs over the Sahel as four of the five AOGCMs (Figures 19c-g) project an increase in the number of extreme rainfall days, and over East Africa as all five AOGCMs predict an increase. While a decrease in the number days over Angola/Zambia is not predicted by any AOGCMs, two of the AOGCMs (Figures 19e, g) do project a decrease further south over Namibia, Botswana, and South Africa. Again there is a marked difference between the RCM and AOGCMs over the Congo, but changes are not found to be significant in any of the model projections.

The average number of *growing season days* per year from the P2-CTL RCM simulations are shown in Figure 20. Again the RCM is able to realistically capture the observed structure of this field (Figure 8a). While still not perfect, there is noticeable improvement in the predicted number of growing season days by the RCM over southeastern Africa compared to P1-L20C (Figure 8b). Figure 21 shows the projected changes in the number of growing season days at mid-21st century (Figures 21a-b) and late 21st century (Figures 21c-d), while Figure 22 shows only the mid-21st century and late-21st century changes that are statistically significant at the 95 percent confidence level. Two significant coherent regions emerge, namely over the Sahel of Africa where there is a 20 to 30 day increase at mid-century and a 30 to 40 day increase at late-century, and over much of southeastern Africa where there is a projected 10 to 40 day decrease at mid-century and greater than 50 day decrease at late-century. The projected change over East Africa and the Horn of Africa in particular is interesting because of how different the RCM projections are between the 90-km and 30-km simulations. The mid-century predictions indicate an increase in the growing season days over the Horn of Africa in the 90-km resolution RCM simulation (Figure 21a), but a decrease in the 30-km resolution RCM simulation (Figure 21b). By late-century there is better agreement between the two, as both predict an increase in growing season days over most of this region. Generally, the East Africa projections are not found to be statistically significant over both of these time slices.

Conclusions

The results from the previous section regarding the extreme climate measures are synthesized into the conclusions below. Note confidence is assessed and assigned based not only on statistical methods (i.e., student's t-test), but also based upon:

- An evaluation of the accuracy of a model's representation of the present day climate, a necessary but not sufficient condition.
- Agreement between RCM Phase 1 and Phase 2 predictions at 90-km resolution, as it assesses the robustness associated with experimental design changes.
- Agreement between the 90-km and 30-km resolution RCM Phase 2 projections, which offers an avenue to understand the impact of model resolution on the robustness of the changes.
- Inter-model agreement between the RCM and CMIP5 AOGCM projected changes, as it tests the model dependency of the projected change.
- An analysis of the physical processes responsible for the change, which can offer an explanation why different models may yield different responses.

Heat Wave Days: There is a high likelihood of the increase in the number of heat wave days per year over Africa during the next century with the magnitude of the change regionally dependent (Figure 11). The largest increases are projected to occur at the southern fringe of the Sahara desert over the Bodélé region of Chad, southwestern Niger/ northern Burkina Faso, and northern Senegal/southern Mauritania, and Mali. Heat waves are also predicted to become more likely south of the Sahel down to around 5°N at mid-21st century, and down into the Congo basin by late-21st century. South of the equator, a significant increase in heat wave days is not predicted until the late-21st century.

Dry Days: Significant changes in the number of dry days per year is highly likely across the Sahel, over the Horn of Africa (i.e., Kenya, Ethiopia, and Somalia), and the southern African region of Angola, Zambia, Malawi, Zimbabwe, and Mozambique (Figures 14-15). Over the Sahel the number of dry days is projected to decrease by 5 to 15 days at mid-century and by 10 to 30 days by late century. Over the Horn of Africa the number of dry days is also expected to decrease with the most widespread and significant changes occurring during the late-21st century. The mid-century projections are not significant and there is greater inter-model uncertainty. Over southern Africa the projections indicate a high likelihood of an increase in the number of dry days by 5 to 20 days at mid-century and 15 to 40 days by late century.

Extreme Heavy Rainfall Days: There is a great likelihood that the number of extreme heavy rainfall days per year will increase over the Sahel and East Africa (Figures 18-19). At mid-century the number of extreme heavy rainfall days is projected to increase by 2 to 6 days over the Sahel, and 1 to 4 days over regions of East Africa. By late-century the number of events increases even more with the spatial pattern becoming even more coherent with strong inter-model agreement. Less certain is the projected decrease in extreme heavy rainfall days over southern Africa. A coherent signal emerges from the RCM simulations in the late-21st century simulations, but it is not observable over the same region in the CMIP5 AOGCMs. It should be noted that the AOGCMs have difficulties simulating a realistic distribution of extreme heavy rainfall days over this region for the present day climate, but not the RCM (Figure 16), so some caution should be placed when interpreting the AOGCM projections here. Confidence in the

projected changes over the Congo is also lower as the AOGCMs, and to some extent the RCM, have difficulties simulating the observed rainfall distribution and extreme rainfall over this region.

Growing Season Days: A significant future increase in the number of growing season days per year is predicted for the Sahel, while a decrease is projected over eastern Angola, southern Democratic Republic of Congo, Zambia, Zimbabwe, Malawi, and Mozambique (Figure 22). Over the Sahel the number of growing season days increase by 10 to 25 days at mid-century and 20 to 40 days at late-century. The response is more spatially robust in the 30-km simulation as the sharp meridional land surface gradients over the Sahel are more realistically represented at this resolution. Over southern Africa the number of growing season days decreases by 10 to 40 days at mid-century and by more than 50 days over many locations. These changes in the number of growing season days are consistent with the predicted precipitation field changes,⁹ in particular with the changes in the number of dry days (Figures 14-15).

These findings are consistent with the current understanding that the impacts of future climate change are likely to be regionally dependent. Some regions are likely to see changes that will be beneficial (e.g., increased rainfall over the Sahel), while other will see changes that are detrimental (e.g., drier conditions over southeastern Africa) that can have important implications to society and agriculture. This suggests the need for regional emphasis to better understand such changes, and why the predicted spread can be large between different models. For example, analysis of the projections indicates that the future Sahelian rainfall increase is associated with the surface warming over the Sahara.⁹ Models that simulate stronger warming over the Sahara are associated with a stronger thermal low over the Sahara, and larger and earlier in the 21st century Sahelian rainfall increases due to an intensification of the moist, low-level southwesterly flow from the Atlantic into the continental interior. This mechanism is not only specific to future climate change, as it can be observed to be influential in present day variability.²³ An analysis of the physical processes responsible for the change over southern hemispheric Africa is still being evaluated.

Figures

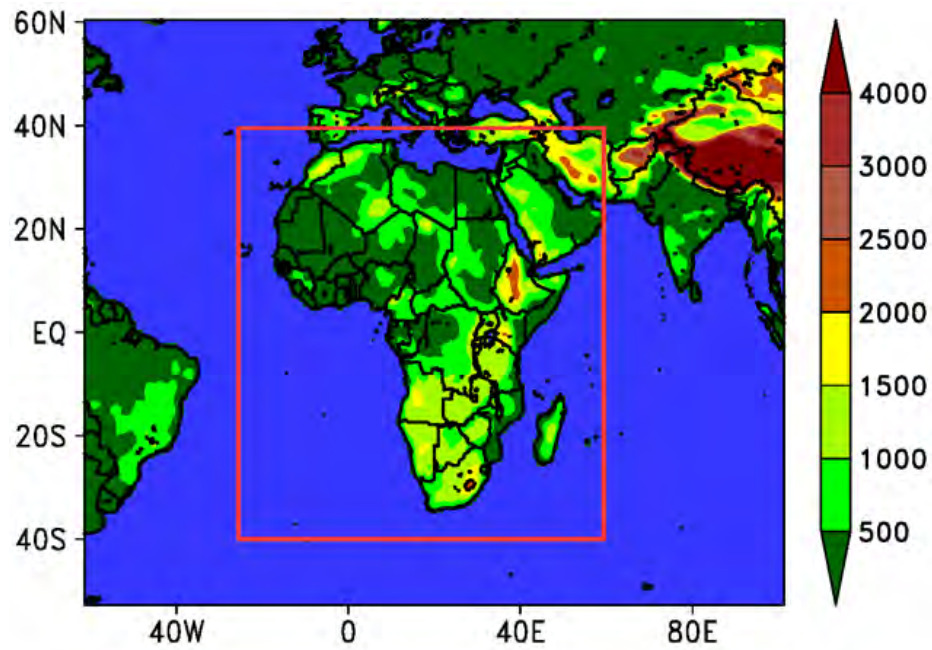


Figure 1. Phase 1 and Phase 2 90-km RCM model domain and topography (meters). Box denotes position of the Phase 2 nested 30-km domain.

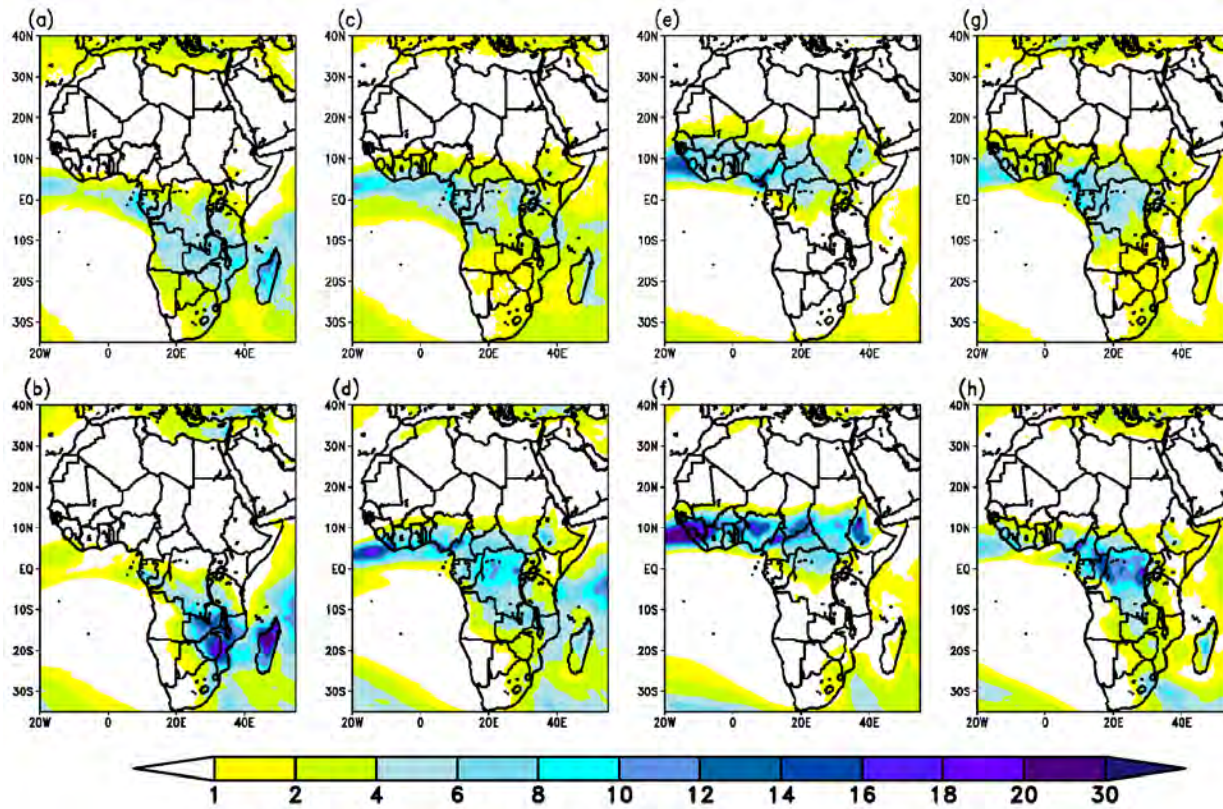


Figure 2. Seasonal rainfall rates (mm day^{-1}) from the (top row) 1998-2010 NASA TRMM 3B42V6 climatology and the (bottom row) RCM P1-L20C ensemble mean. (a) and (b) are for December – February, (c) and (d) are for March – May, (e) and (f) are for June – August, and (g) – (h) are for September – November. From Cook and Vizzy (2012).

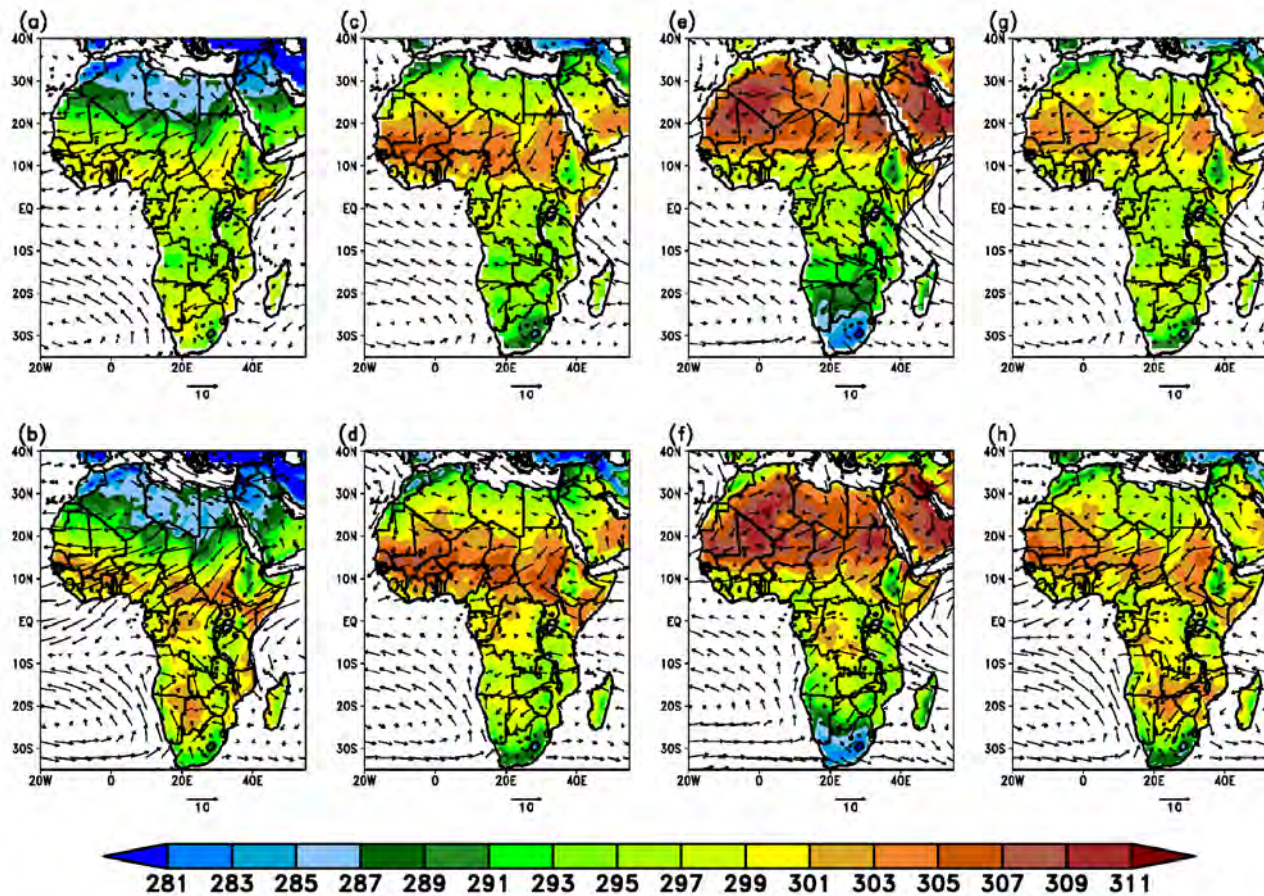


Figure 3. Seasonal surface air temperature (K) and 850 hPa winds (m s^{-1}) from the (top row) 1989-2009 ERA Interim climatology and the (bottom row) RCM P1-L20C ensemble mean. (a) and (b) are for December – February, (c) and (d) are for March – May, (e) and (f) are for June – August, and (g) – (h) are for September – November. From Cook and Vizy (2012).

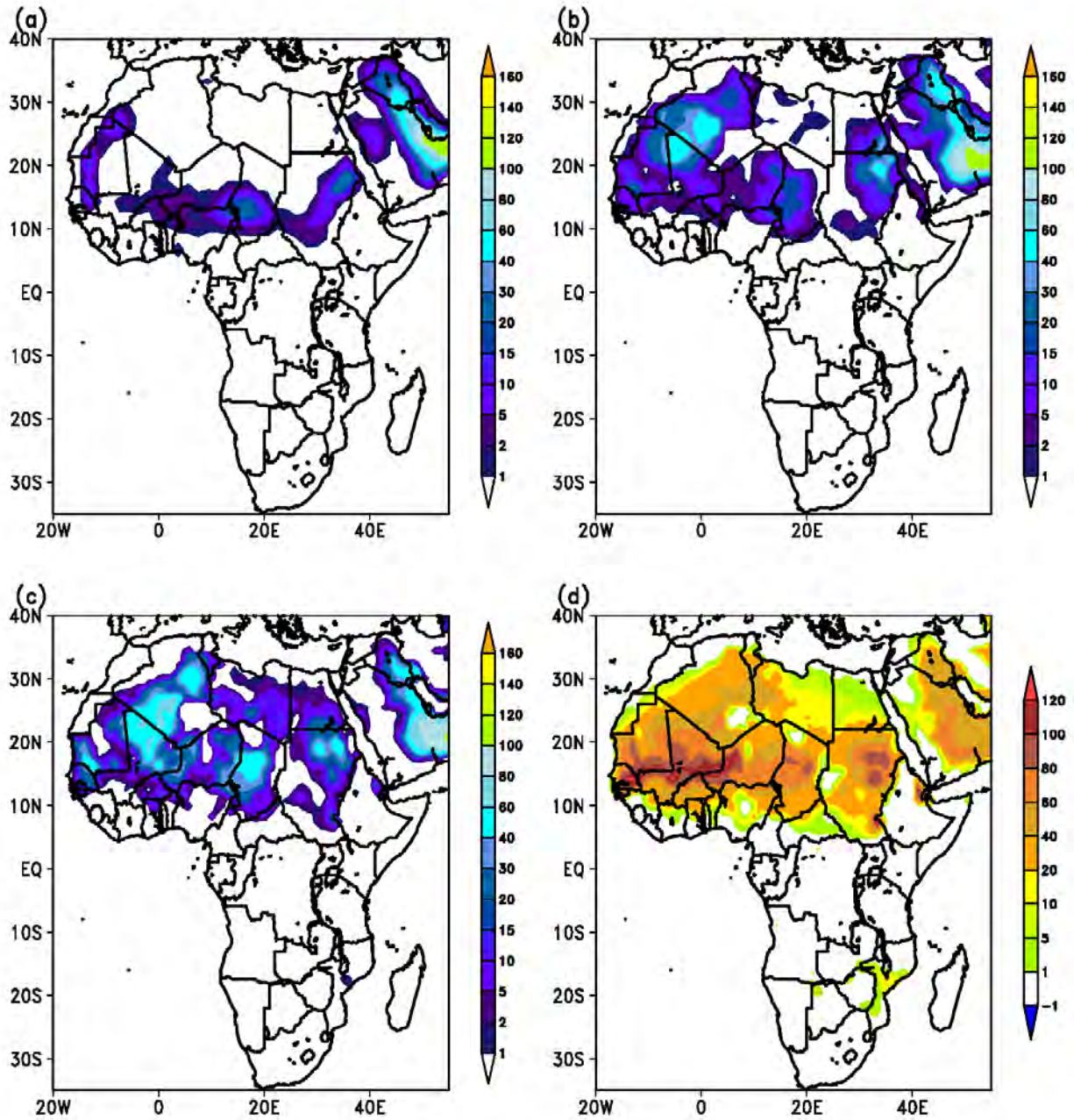


Figure 4. Average number of heat wave days per year from the (a) NCEP2 reanalysis (1989-2009 average), (b) ERA Interim reanalysis (1989-2009 average), and (c) P1-L20C ensemble (6-member average). (d) P1-M21C minus P1-L20C difference in the average number of heat wave days per year. Adapted from Vizy and Cook (2012).

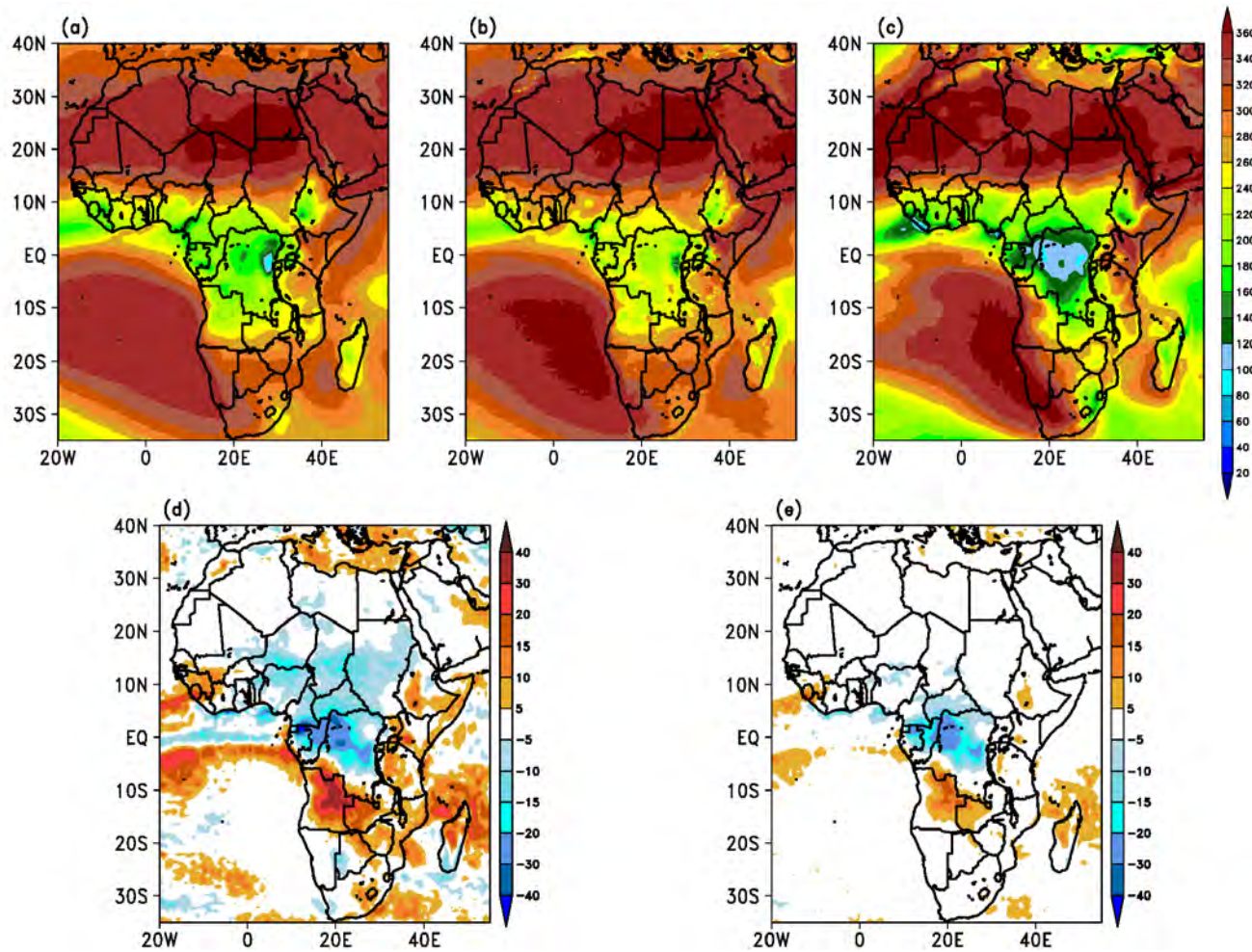


Figure 5. Average number of dry days per year (i.e., when the daily rainfall is less than 1 mm day⁻¹) in the (a) 1997-2008 GPCP 1° daily precipitation climatology, (b) 1998-2011 TRMM climatology, and (c) P1-L20C ensemble (6-member average). Also shown are the (d) difference for P1-M21C minus P1-L20C in the number of dry days per year and the (e) P1-M21C minus P1-L20C percent change difference. Adapted from Vizy and Cook (2012).

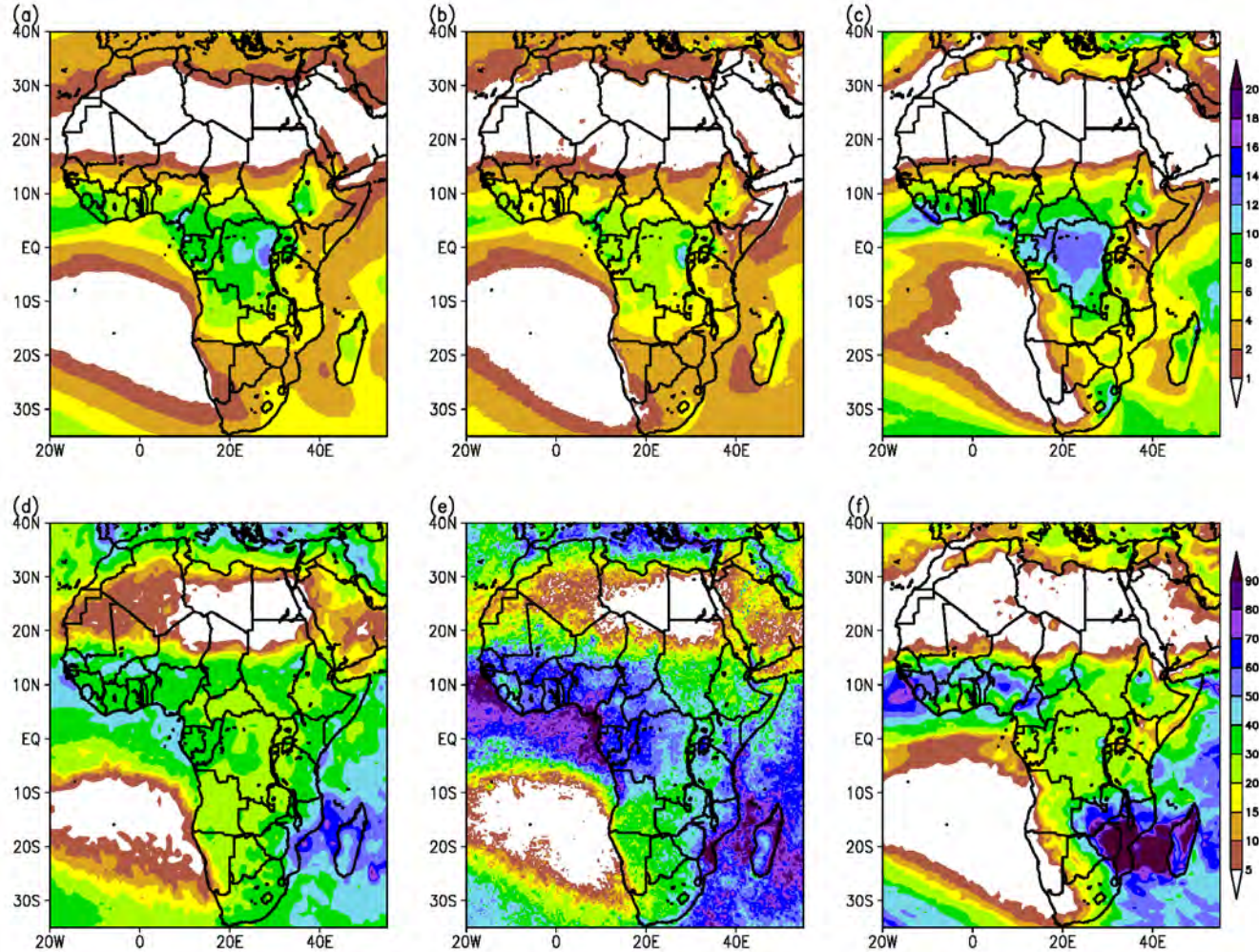


Figure 6. Average number of extreme heavy rainfall days per year for the (a) 1997-2008 GPCP 1° daily product, (b) 1998-2010 TRMM 3B42V6 product, and (c) P1-L20C ensemble using the 95th percentile for rainy days (i.e., daily precipitation ≥ 1 mm/day) to define an extreme rainfall day. Also shown is the average rainfall intensity per extreme wet day (mm day^{-1}) for the (d) GPCP, (e) TRMM, and (f) P1-L20C ensemble. Adapted from Vizy and Cook (2012).

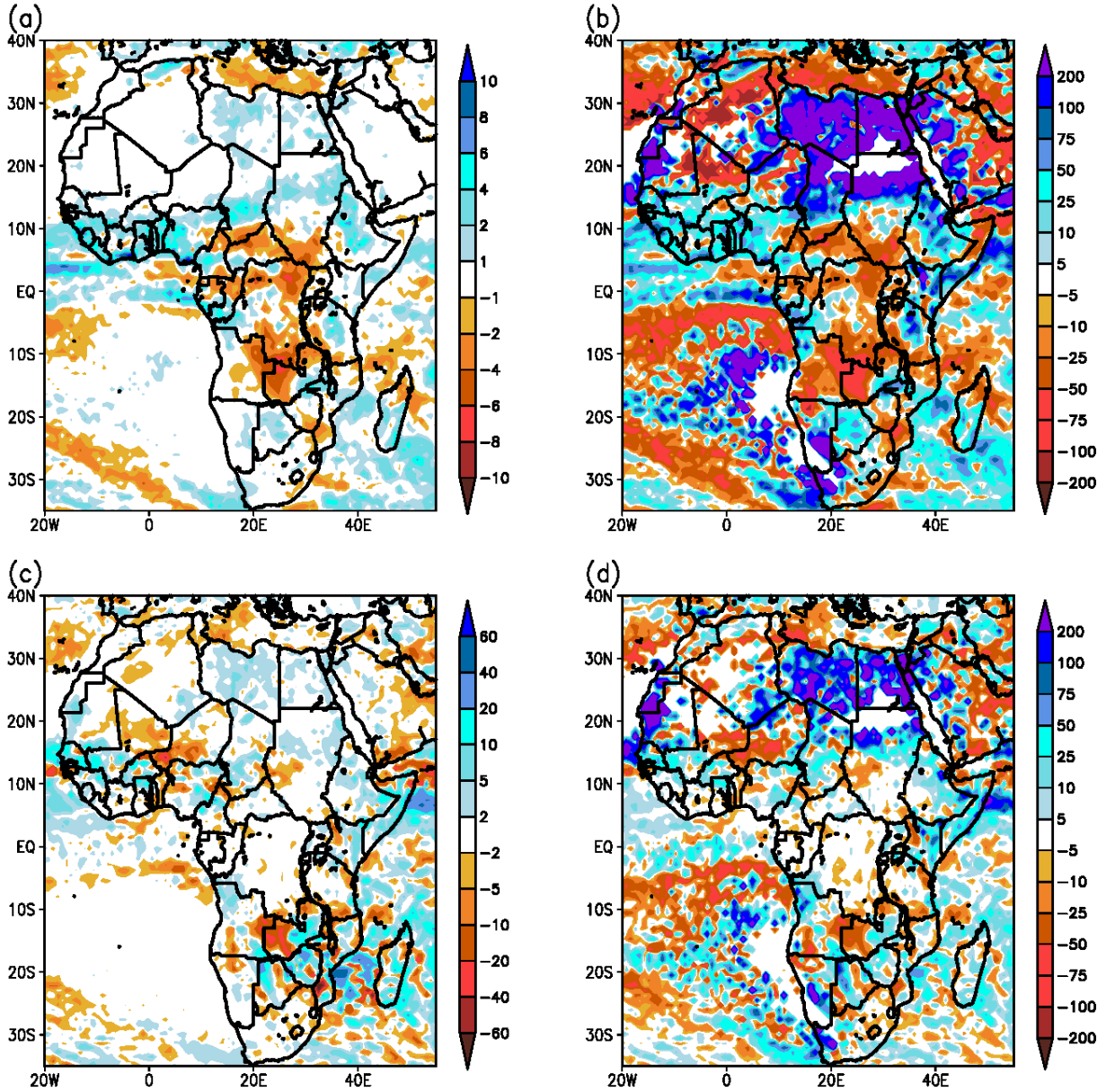


Figure 7. Ensemble mean (a) P1-M21C minus P1-L20C difference and (b) P1-M21C percentage change in the number of extreme wet rainfall days per year using 95th percentile of rainy days to identify extreme wet days. Also shown are the ensemble mean (c) P1-M21C minus P1-L20C difference (mm day⁻¹) and (d) P1-M21C percentage change in the extreme wet rainfall intensity per event using 95th percentile of rainy days to identify extreme wet days. Adapted from Vizy and Cook (2012).

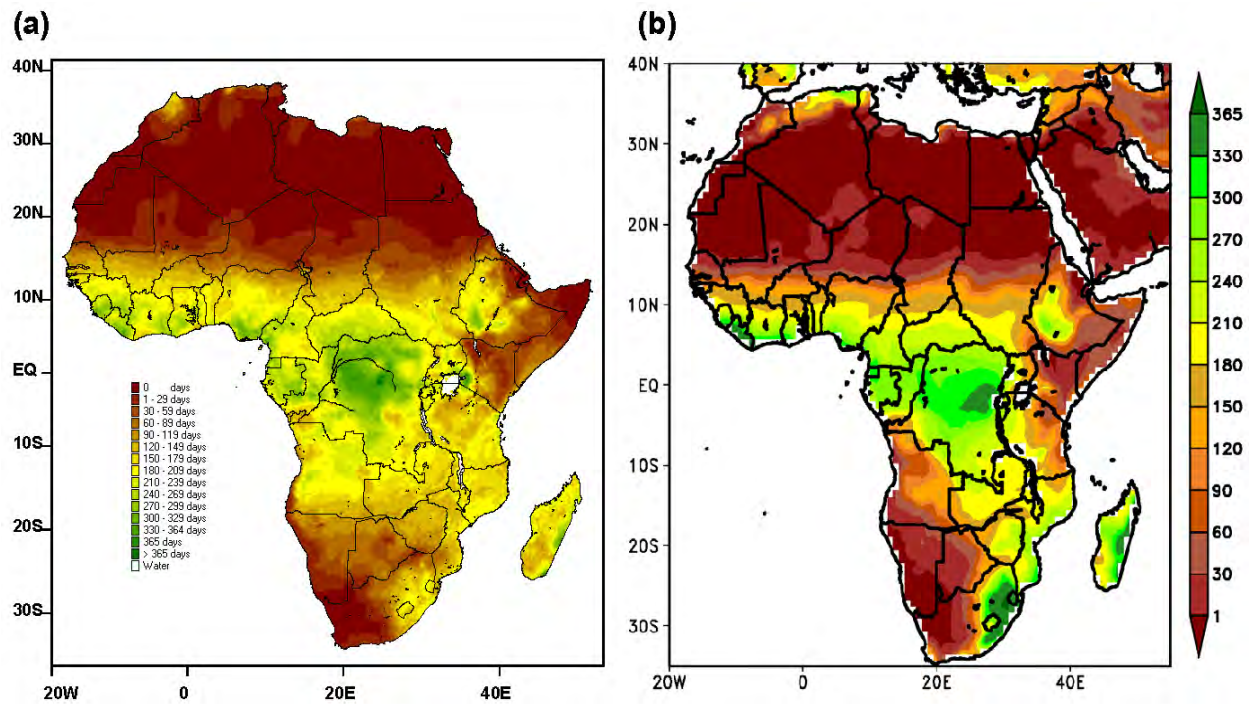


Figure 8. Calculated growing season days from the (a) Food and Agriculture Organization of the United Nations Natural Resources Climate, Energy, and Tenure Division (FAO/NRC; http://www.fao.org/nr/climpag/cropfor/lgp_en.asp), and the (b) P1-L20C ensemble mean. Note the color scales differ slightly between panels. From Cook and Vizy (2012).

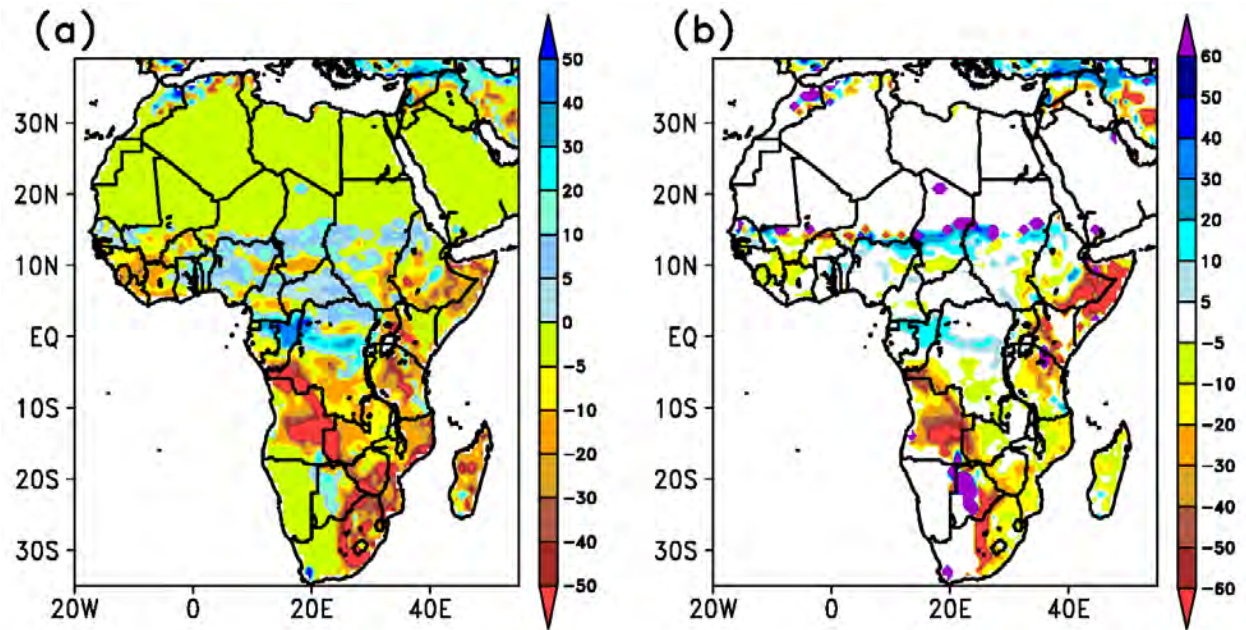


Figure 9. P1-M21C minus P1-L20C difference in growing season days expressed as the number of days and (b) as a percent change from the number of days in the P1-L20C ensemble-mean value at each grid point. From Cook and Vizy (2012).

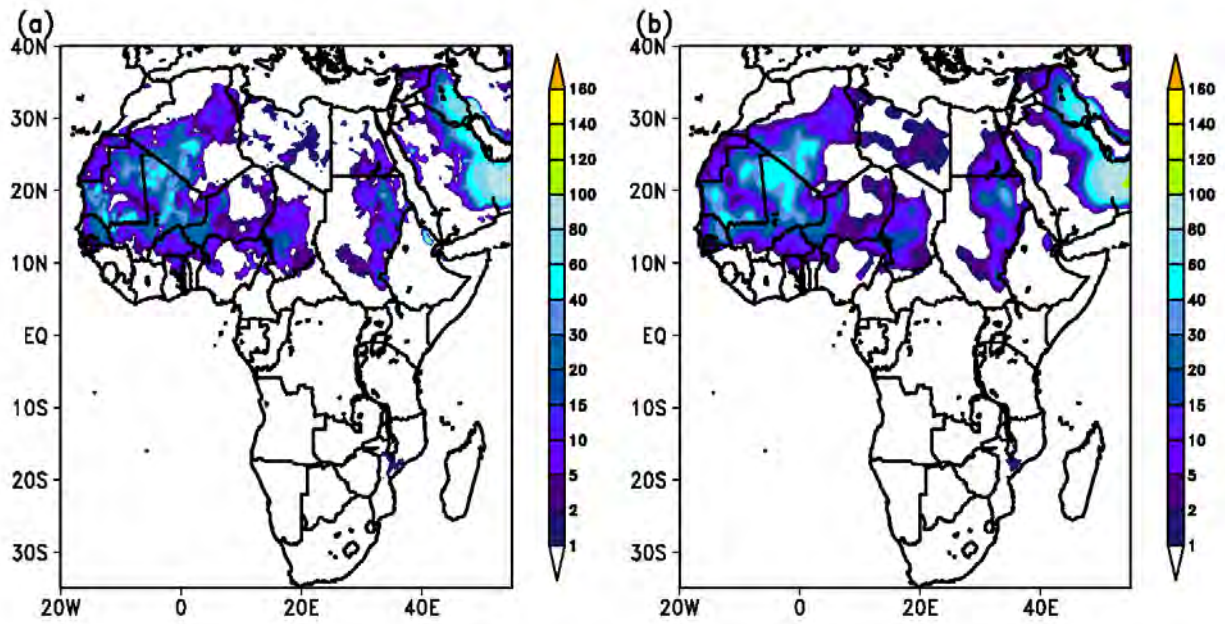


Figure 10. Average number of heat wave days per year from the P2-CTL (a) 30-km resolution and (b) 90-km resolution ensembles (20-member average).

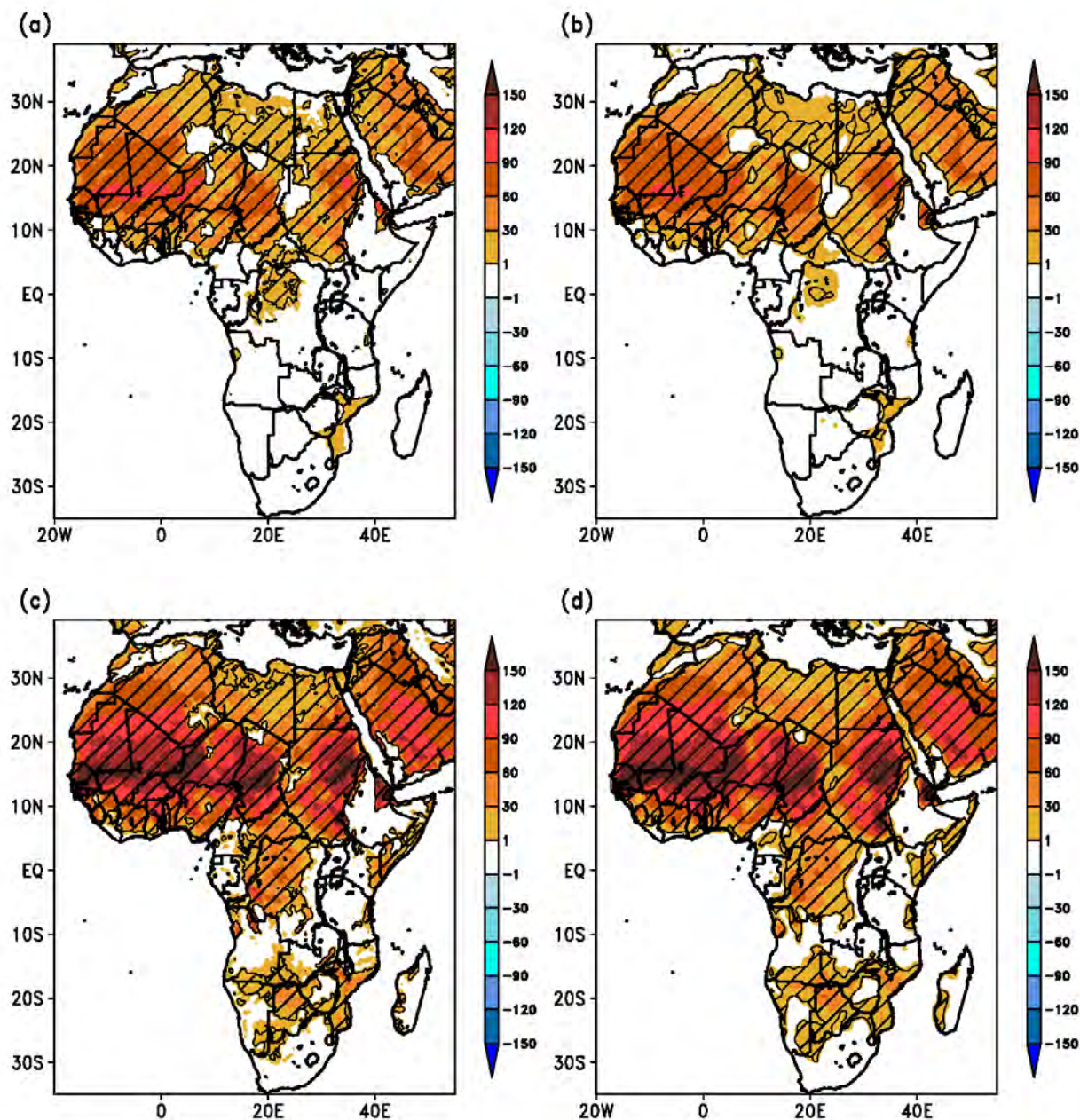


Figure 11. P2-MID21 minus P2-CTL difference in the average number of heat wave days per year for the (a) 30-km and (b) 90-km resolution simulations. (c) and (d) are the same as (a) and (b), respectively, but for the P2-LATE21 minus P2-CTL difference in the average number of heat wave days per year. Hatching denotes changes statistically significant at the 99 percent level of confidence using a student's t-test.

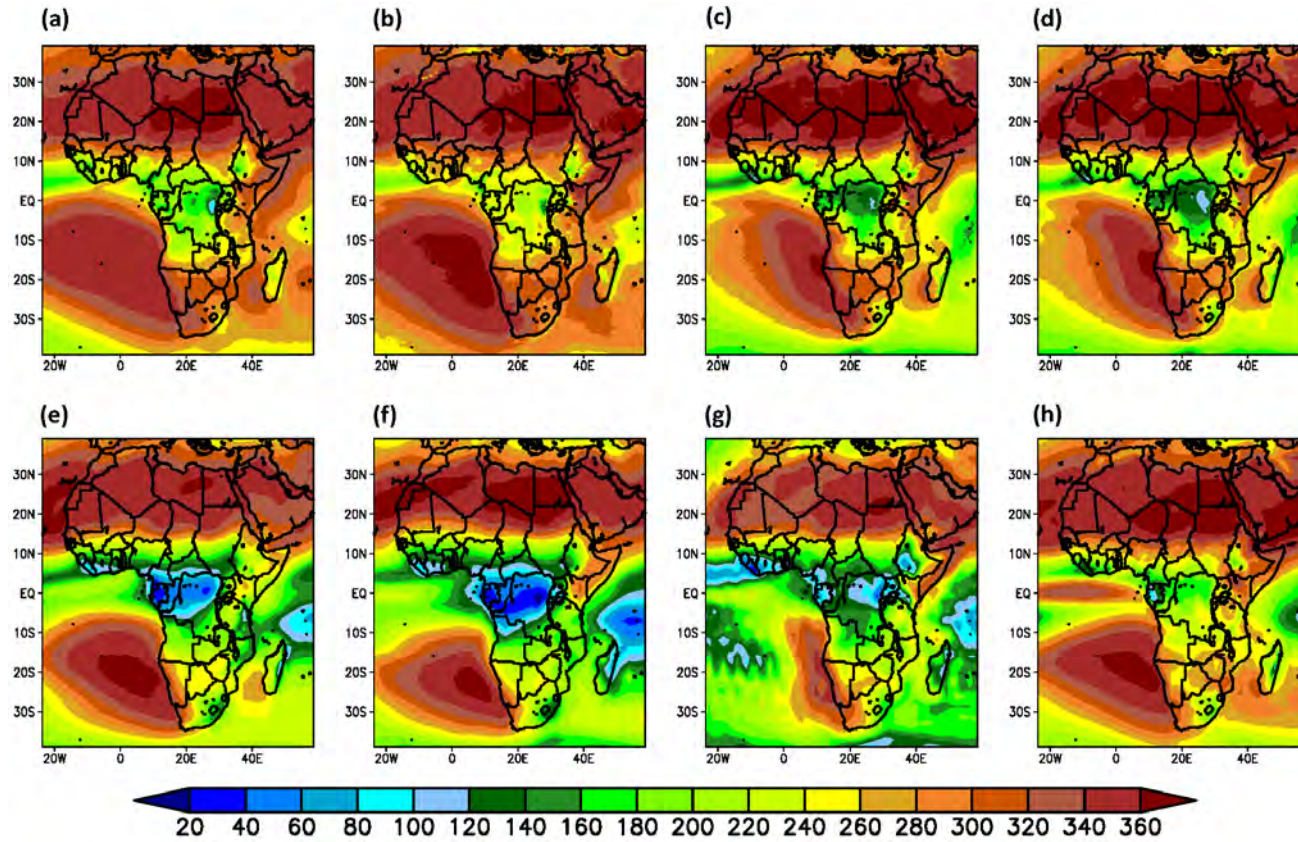


Figure 12. Average number of dry days per year (i.e., when the daily rainfall is less than 1 mm day⁻¹) in the (a) 1997-2008 GPCP 1° daily precipitation climatology, (b) 1998-2012 TRMM 3B42V7 climatology, (c) P2-CTL 30-km RCM, (d) P2-CTL 90-km RCM, and the CMIP5 historical (e) NCAR CCSM4, (f) GFDL-CM3, (g) MIROC5, and (h) MRI-CGCM3 AOGCMs.

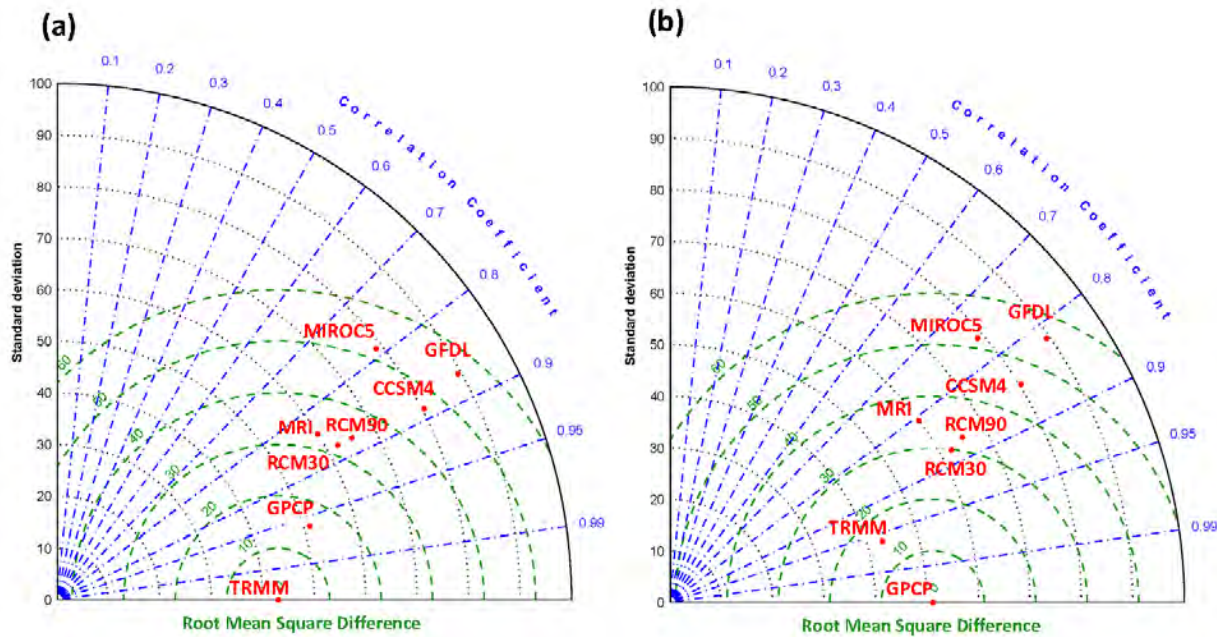


Figure 13. Taylor diagrams of the spatial variability of the mean annual frequency of the number of dry days per year computed over the entire analysis region shown in Fig. 10 where (a) TRMM 3B42V7 and (b) GPCP are used as the reference dataset. The radial coordinate (black dotted lines) gives the magnitude of total standard deviation. The angular coordinate (blue dash-dot lines) gives the correlation with TRMM in (a) and GPCP in (b), selected as the reference dataset. The distance between the reference dataset and each model is proportional to the root mean-square error (green dashed lines).

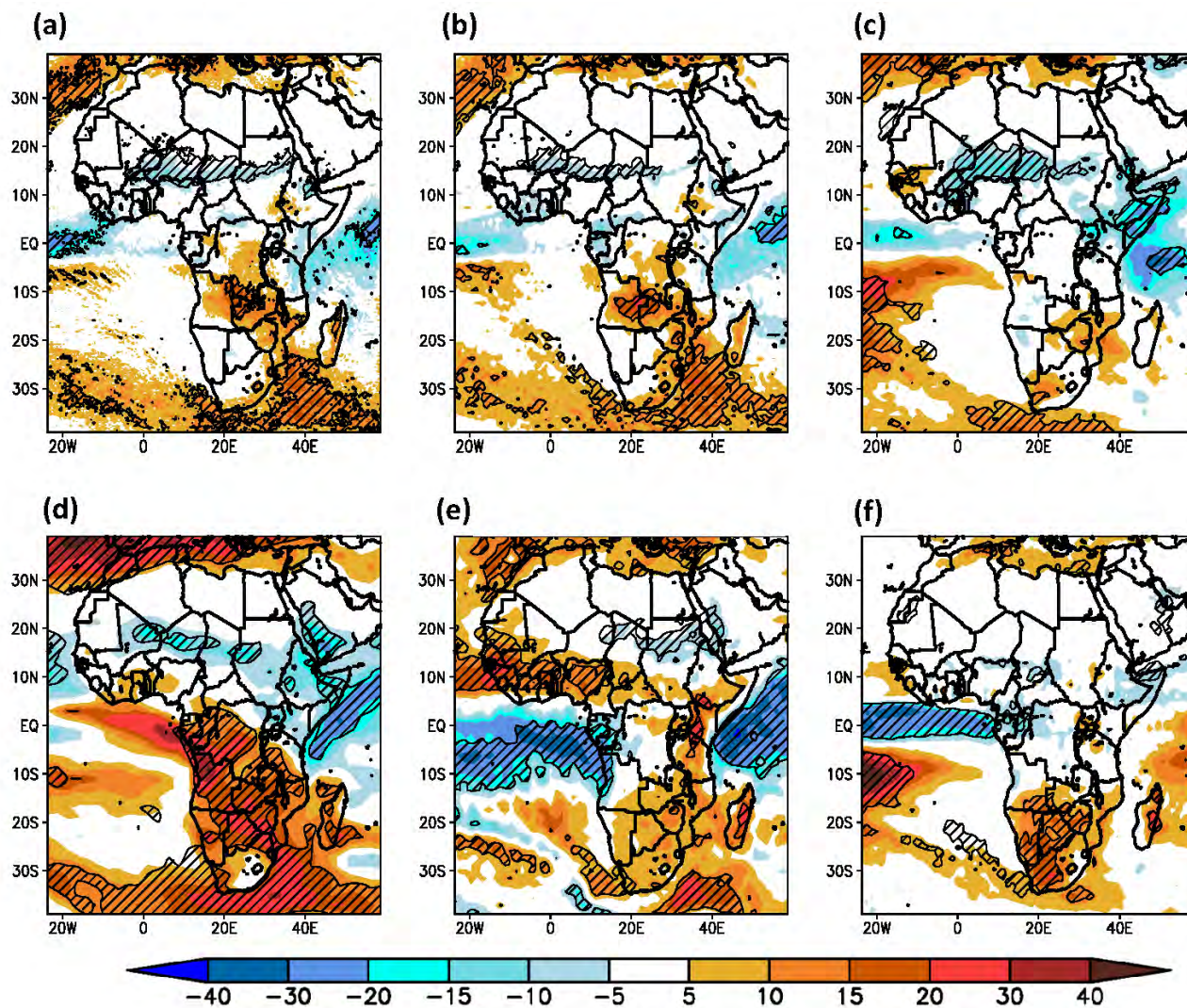


Figure 14. Projected mid-21st century (2041-2060) difference in the number of dry days per year from (a) P2-M21 30-km RCM, (b) P2-M21 90-km RCM, and the CMIP5 RCP8.5 (c) NCAR

CCSM4, (d) GFDL-CM3, (e) MIROC5, and (f) MRI-CGCM3 AOGCMs. Hatching denotes changes statistically significant at the 99 percent level of confidence using a student's t-test.

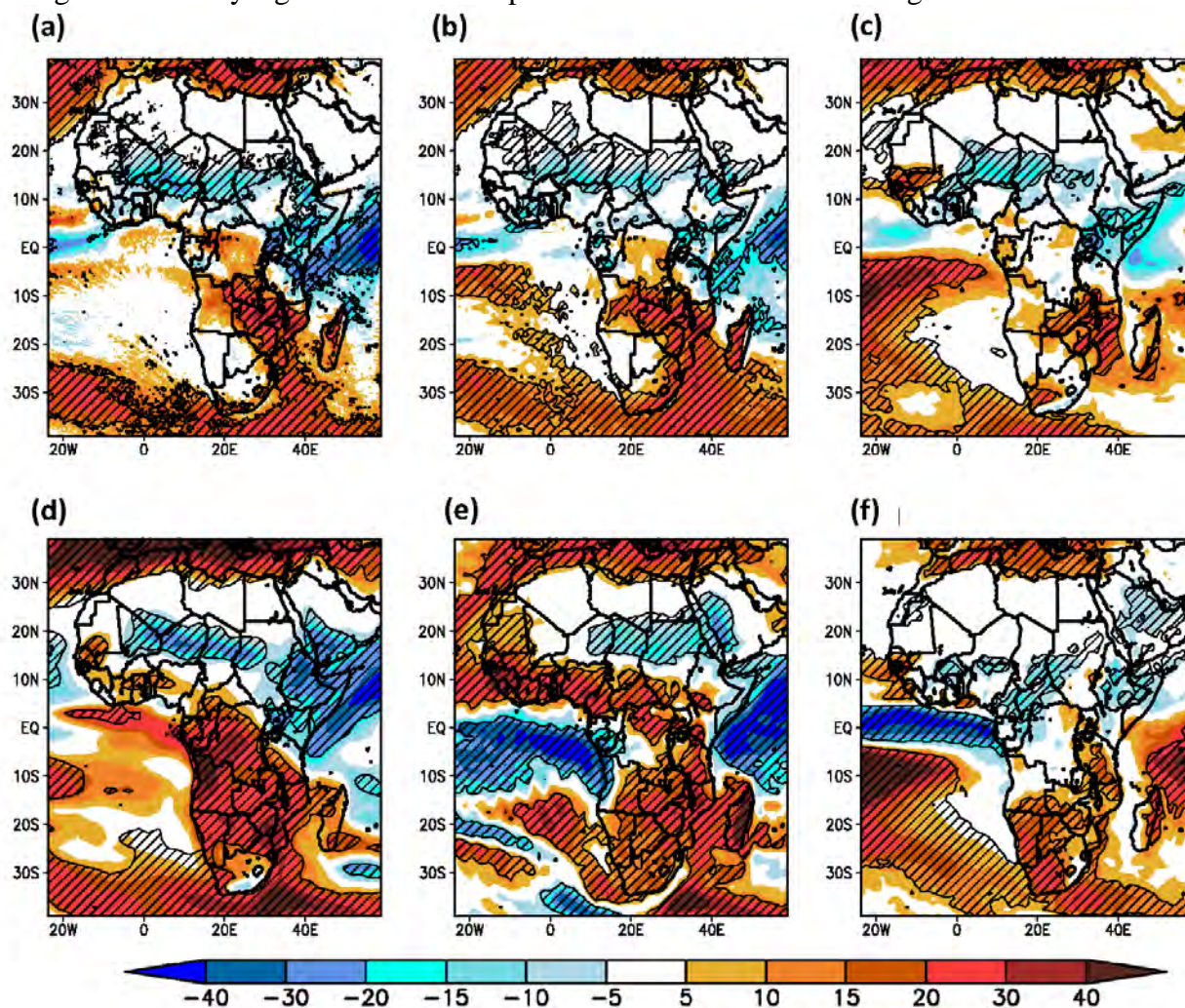


Figure 15. Projected late-21st century (2081-2100) difference in the number of dry days per year from (a) P2-L21 30-km RCM, (b) P2-L21 90-km RCM, and the CMIP5 RCP8.5 (c) NCAR

CCSM4, (d) GFDL-CM3, (e) MIROC5, and (f) MRI-CGCM3 AOGCMs. Hatching denotes changes statistically significant at the 99 percent level of confidence using a student's t-test.

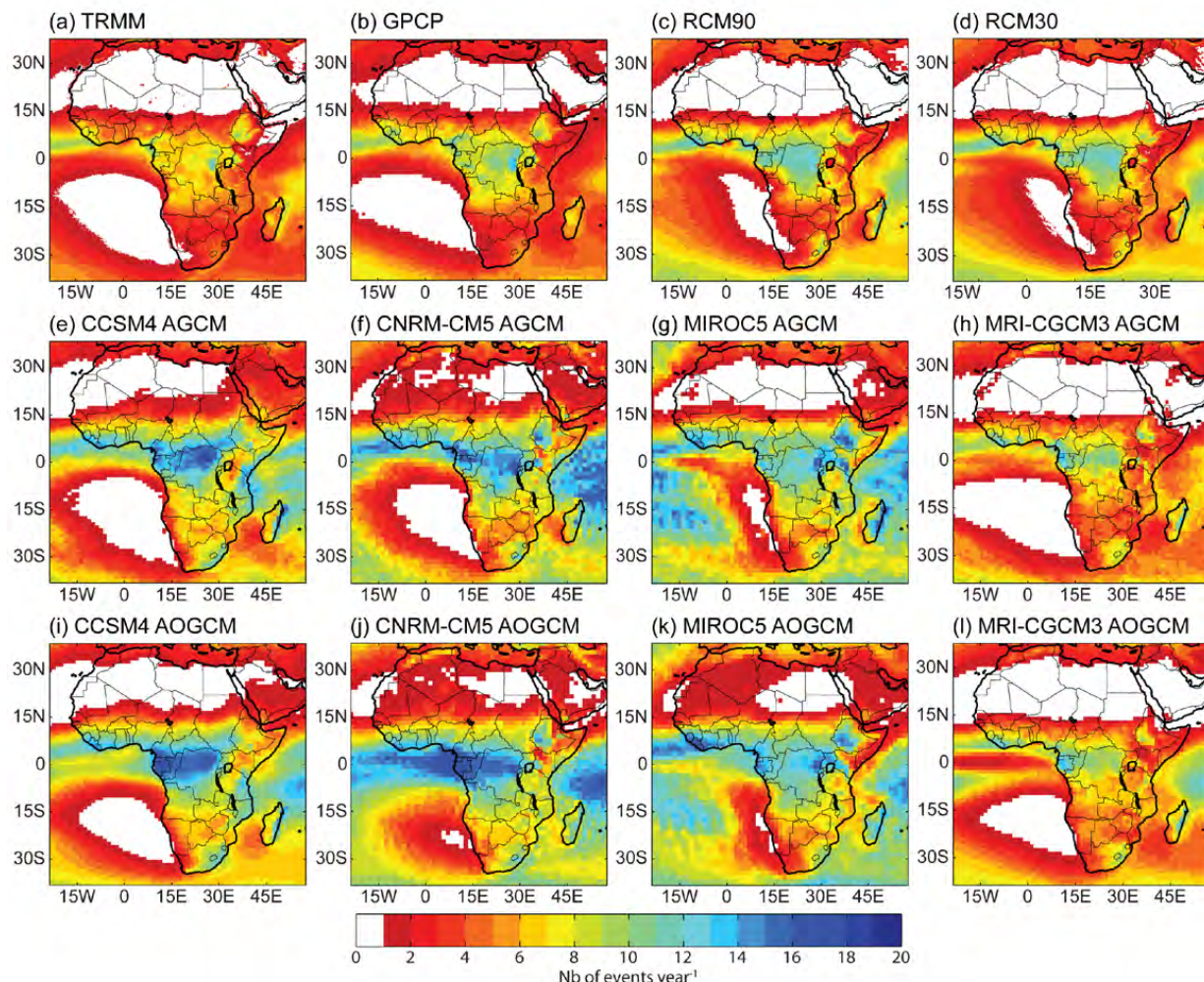


Figure 16. Average number of extreme heavy rainfall days per year for the (a) 1997-2008 GPCP 1° daily product, (b) 1998-2011 TRMM 3B42V6 product, the P2-CTL ensemble at (c) 90-km and (d) 30-km resolution, the CMIP5 AMIP (e) NCAR CCSM4, (f) CNRM-CM5, (g) MIROC5, and (h) MRI-CGCM3 AGCM and CMIP5 historical (i) NCAR CCSM4, (j) CNRM-CM5, (k) MIROC5, and (l) MRI-CGCM3 AOGCM simulations. Extreme heavy rainfall days are determined using the 95th percentile for rainy days (i.e., daily precipitation ≥ 1 mm/day) to define an extreme rainfall day. AGCM and AOGCMs are averages over the last 20-years of each experiment. From Cr  tat et al. (2012).

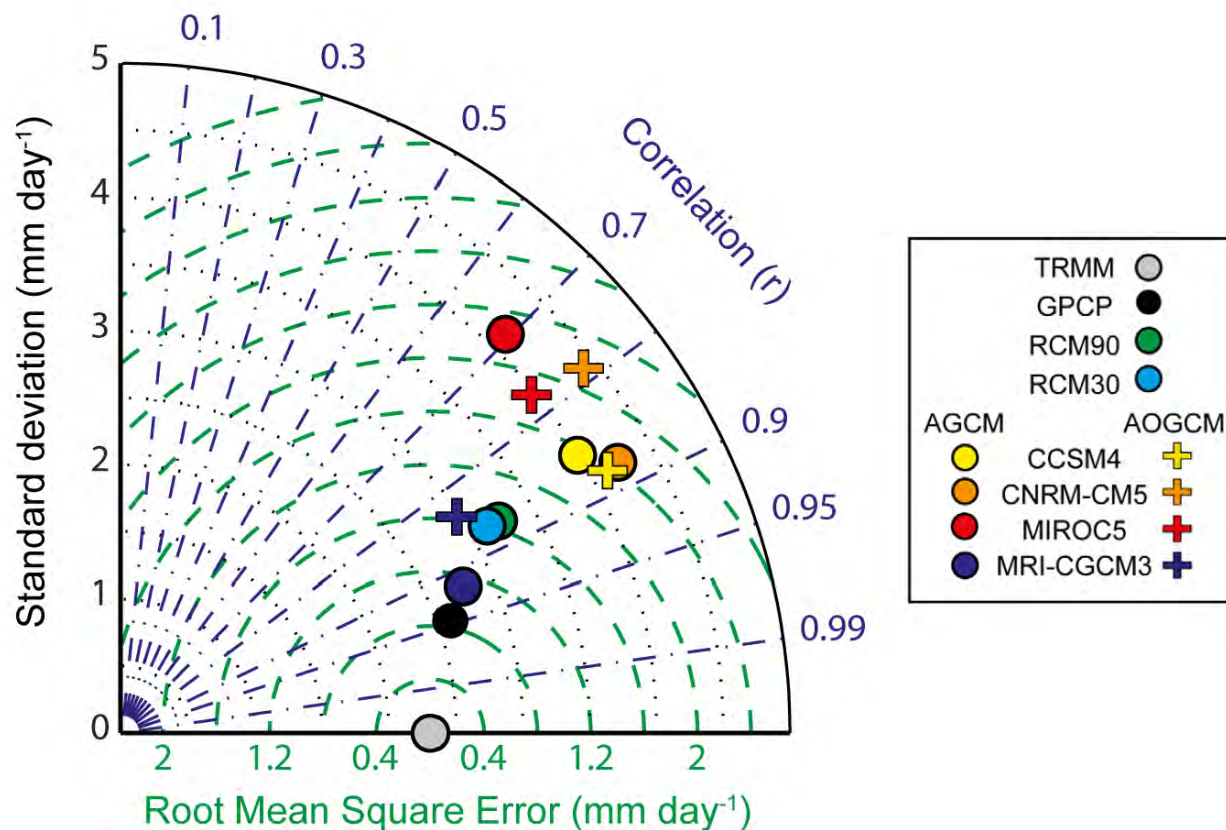


Figure 17. Taylor diagram of the spatial variability of the Average number of extreme heavy rainfall days computed over the analysis region shown in Figure 16. The radial coordinate (black dotted lines) gives the magnitude of total standard deviation. The angular coordinate (blue dash-dot lines) gives the correlation with TRMM, selected as the reference dataset. The distance between TRMM and each model is proportional to the root mean-square error (green dashed lines). From Cr  tat et al. (2012).

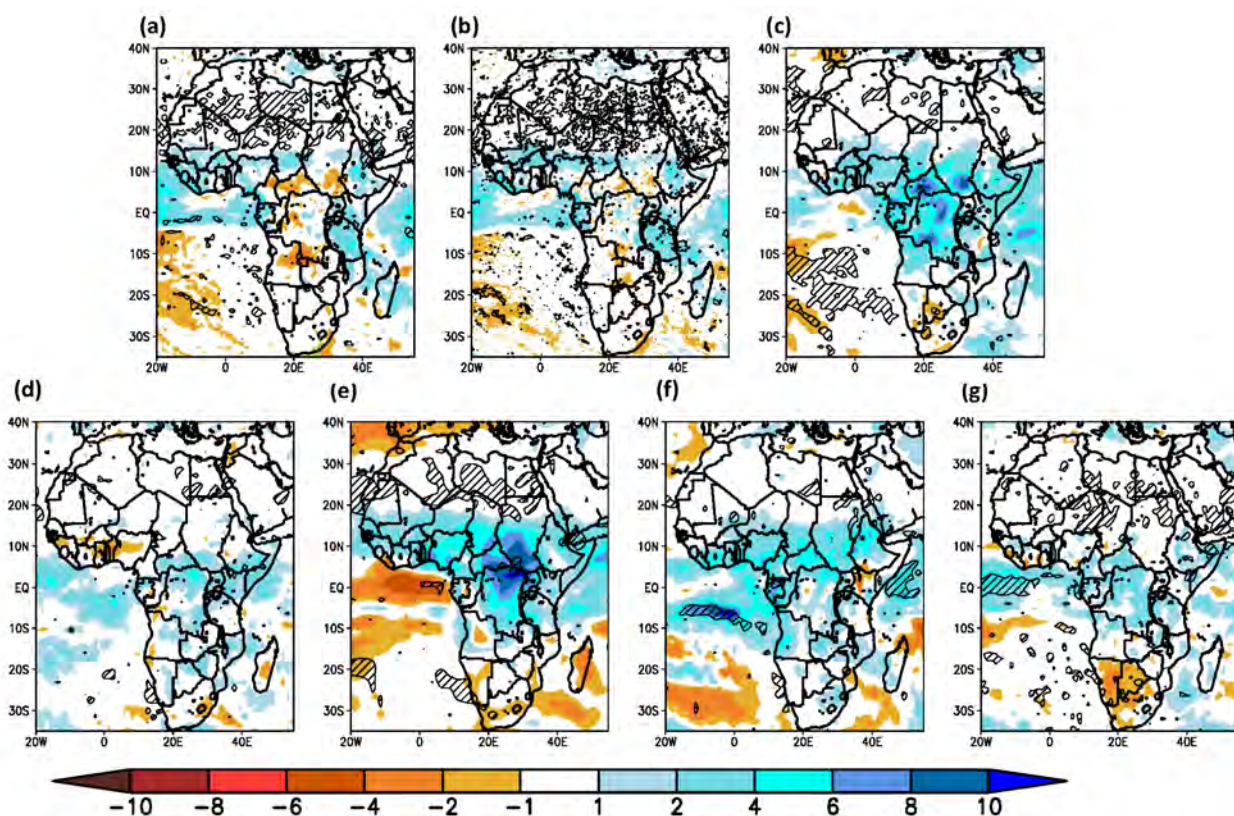


Figure 18. Mid-21st Century (2041-2060) projected differences in the number of extreme wet rainfall days per year using 95th percentile of rainy days to identify extreme wet days for P2-MID21 RCM at (a) 90-km and (b) 30-km resolution, and the CMIP5 RCP8.5 (c) NCAR CCSM4, (d) CNRM-CM5, (e) GFDL-CM3, (f) MIROC5, and (g) MRI-CGCM3 AOGCMs. Hatching denotes changes statistically significant at the 90 percent level of confidence using a student's t-test.

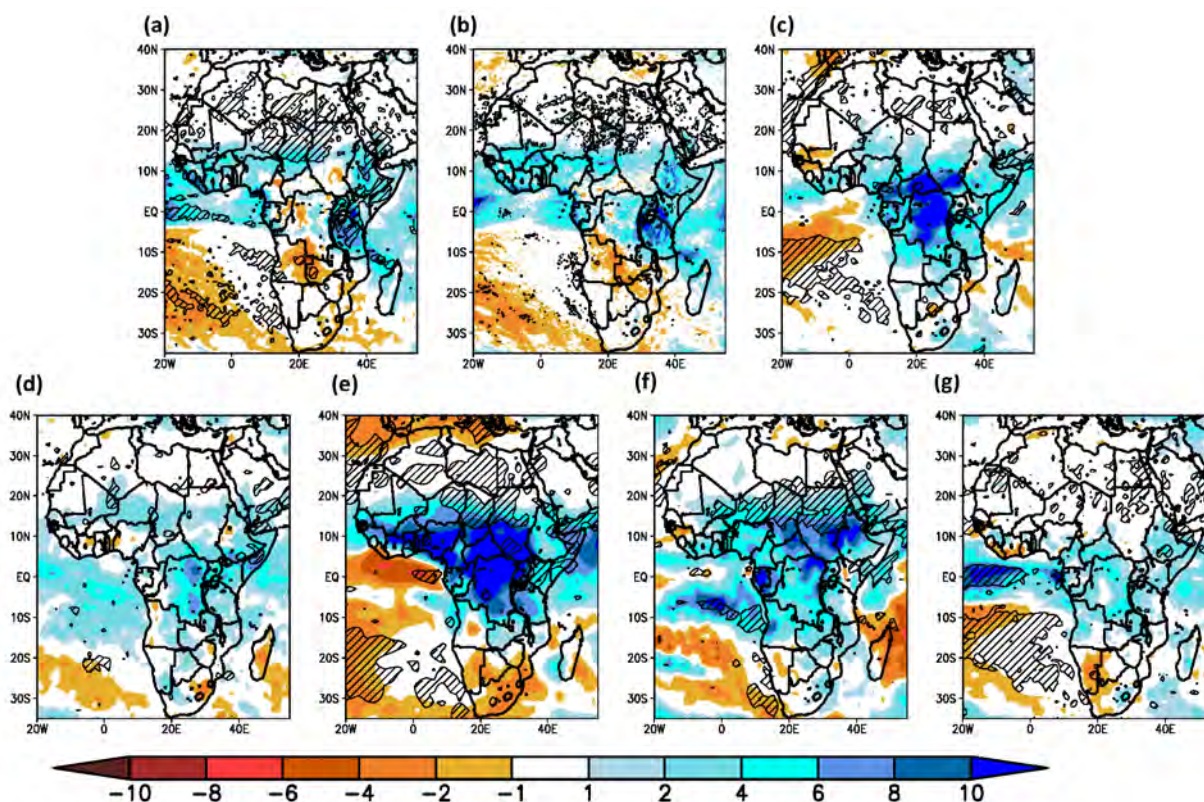


Figure 19. Late-21st Century (2081-2100) projected differences in the number of extreme wet rainfall days per year using 95th percentile of rainy days to identify extreme wet days for P2-LATE21 RCM at (a) 90-km and (b) 30-km resolution, and the CMIP5 RCP8.5 (c) NCAR CCSM4, (d) CNRM-CM5, (e) GFDL-CM3, (f) MIROC5, and (g) MRI-CGCM3 AOGCMs. Hatching denotes changes statistically significant at the 90 percent level of confidence using a student's t-test.

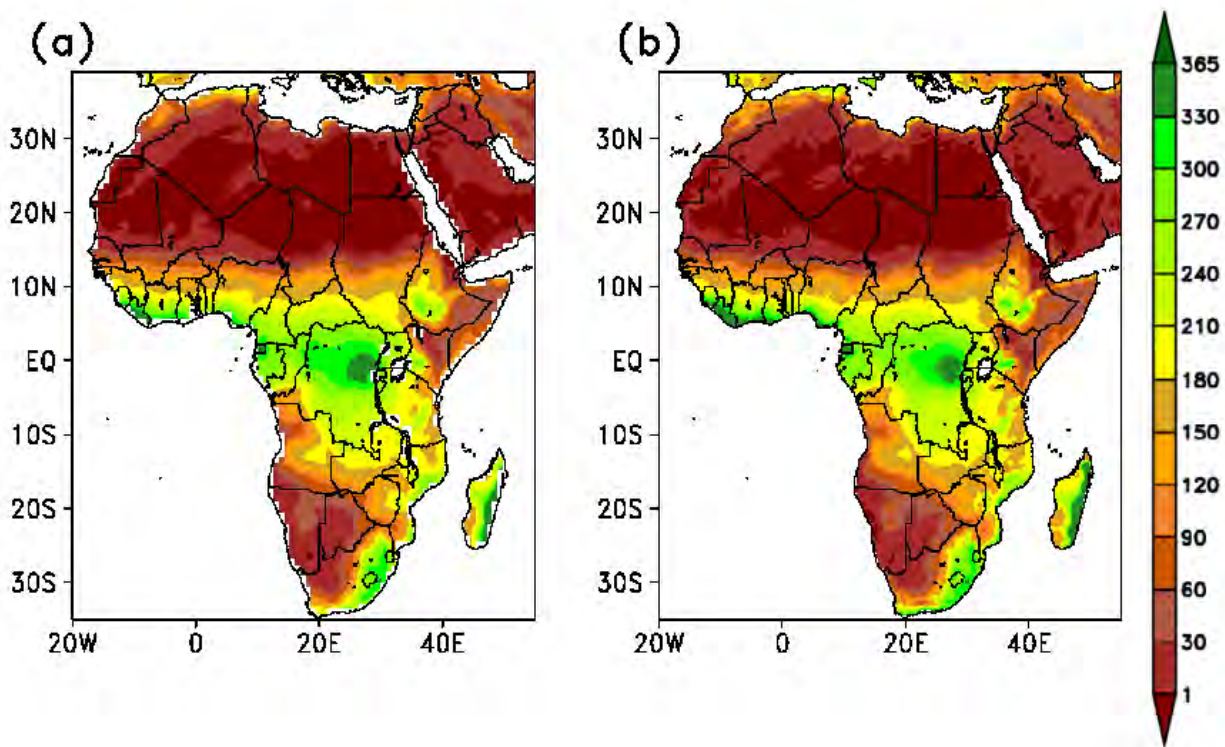


Figure 20. Calculated growing season days per year from the P2-CTL RCM at (a) 90-km and (b) 30-km resolution.

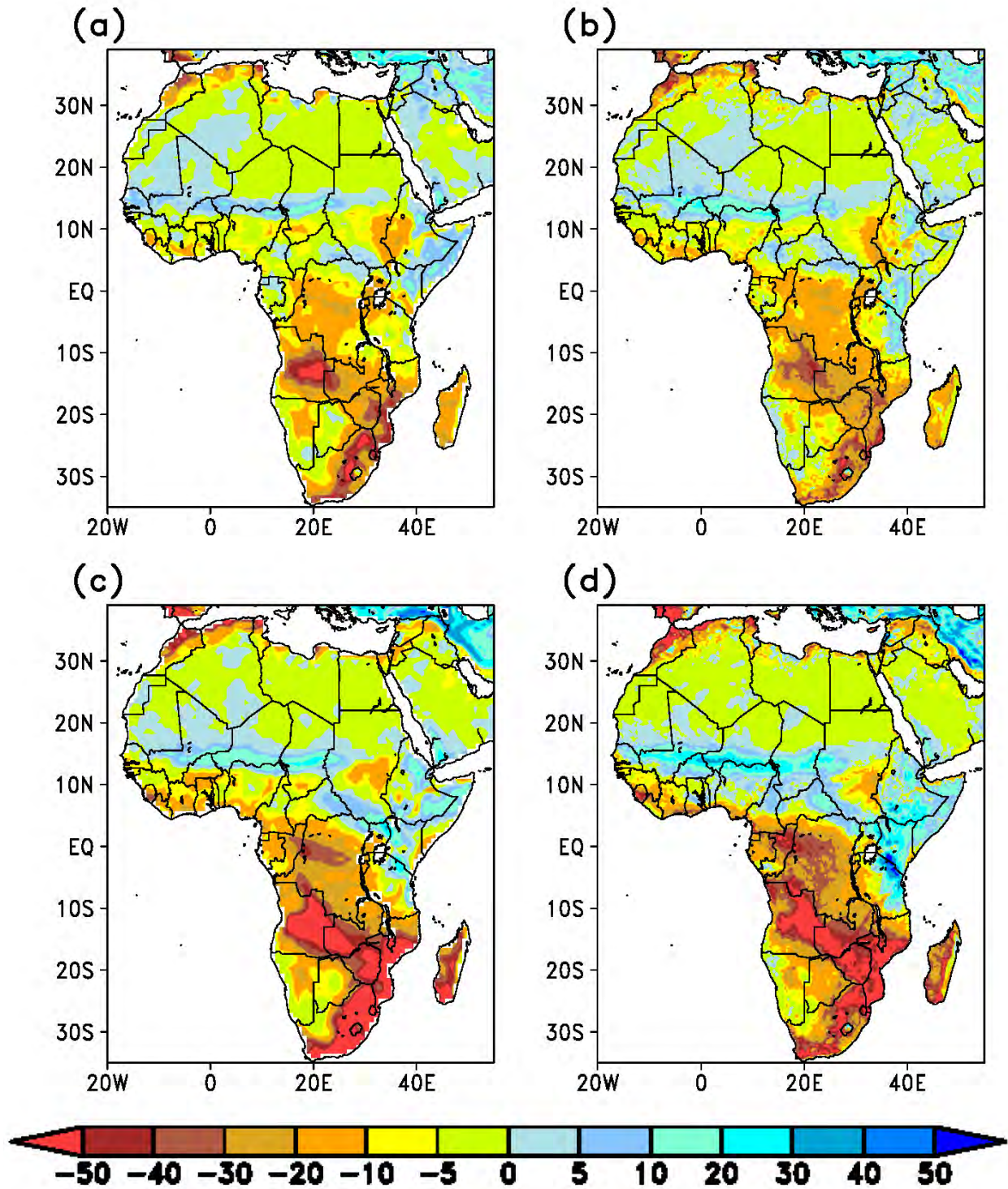


Figure 21. Predicted mid-21st century (2041-2060) average changes in the number of growing season days simulated by the P2-MID21 at (a) 90-km and (b) 30-km resolution. (c) and (d) are the same as (a) and (b), respectively, except for the late-21st century (2081-2100) from the P2-LATE21 simulations.

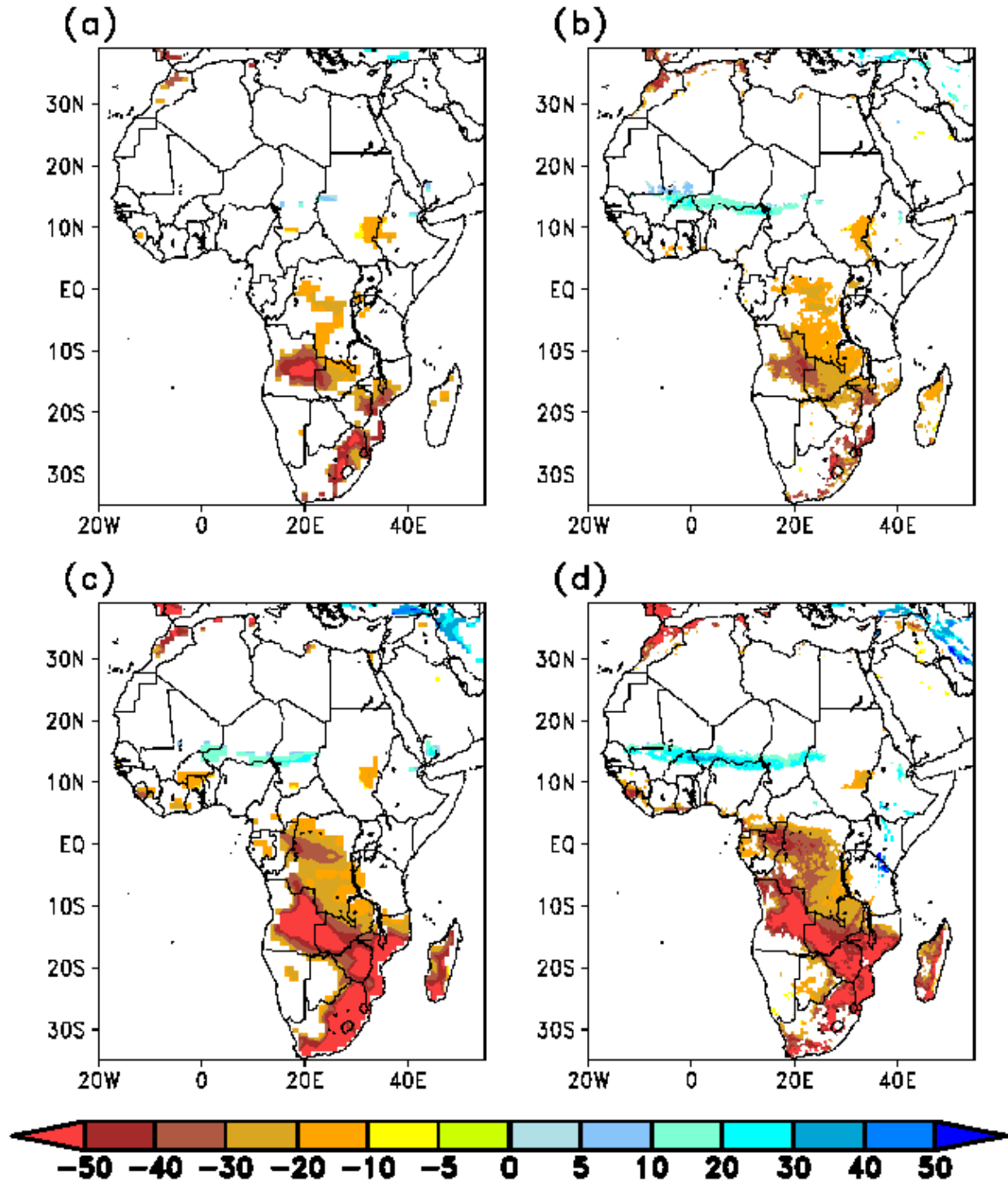


Figure 22. Statistically significant (at the 95 percent level of confidence) predicted mid-21st century (2041-2060) average changes in the number of growing season days simulated by the P2-MID21 at (a) 90-km and (b) 30-km resolution. (c) and (d) are the same as (a) and (b), respectively, except for the late-21st century (2081-2100) from the P2-LATE21 simulations. Statistical significance is assessed via a student's t-test.

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Chapter 3. Climate Change and Conflict: Outcomes, Context, and Causal Pathways

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Executive Summary

The climate change and conflict component of the Climate Change and African Political Stability (CCAPS) program sought to shed light on linkages between environmental stress and conflict. Researchers compiled the Social Conflict in Africa (now Analysis) Database, which tracks social unrest such as protests, riots, and small-scale attacks short of major armed conflict, in order to address the full spectrum of conflict behavior. These data have now become a major resource for analysis by scholars and practitioners. Studies on the climate-conflict relationship included research on social unrest, civil wars and insurgencies, as well as interstate conflict, attesting to the wide range of conflict behavior under consideration by the CCAPS team. Results from peer-reviewed publications suggest that protests, riots, and other disturbances are more likely when rainfall is either too scarce or too abundant. However, armed conflicts, which require provisioning professional militants, become less frequent and severe under conditions of drought. Moreover, interstate conflicts also become less frequent when countries experience drought conditions. Finally, sharp increases in food prices—one potential consequence of climate change—can lead to significant unrest. From a policy standpoint, the results suggest that modernizing agricultural practices and promoting sustainable development can help reduce the risk of conflict caused by environmental stress.

Introduction

Over the past decade, climate change has emerged as a significant issue on the security agenda, both in the U.S. and abroad. In 2010, for the first time ever, the U.S. Quadrennial Defense Review (QDR), the most prominent public statement of Department of Defense strategy and priorities, listed climate change as a critical threat to national security, stating “climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fragile governments.”¹ That same year, a UK Defence Ministry green paper forecast that climate change would increase international instability and pose threats to British interests. These prominent statements came three years after the Norwegian Nobel Committee awarded the 2007 Nobel Peace Prize to Al Gore and the Intergovernmental Panel on Climate Change (IPCC), on the premise that climate change can “fuel violence and conflict within and between states.”² Climate change is now widely viewed as a threat to both national and human security.

Its emergence as an area of concern, however, has often surpassed the ability of the scholarly community to provide rigorous, empirically sound descriptions of climate-related threats. While the 2007 IPCC report contained several references to potential links between climate change and conflict, these links were tenuous and not grounded in an extensive peer-reviewed literature on the subject. Indeed, one of the co-PIs of this project noted in 2008 that there was “no consensus yet” on whether climate change would exert systematic effects on global peace and security.³

In the absence of rigorous analysis to inform planning, policymakers were in part filling the void with dramatic, but unsubstantiated, conjectures of a future of rampant water wars and mass upheaval in developing countries. In 2003, Peter Schwartz and Doug Randall published *An Abrupt Climate Change Scenario and Its Implications for United States National Security*, an extreme climate change scenario commissioned by the U.S. Department of Defense. In it, they challenged U.S. strategic planners to “Envision Pakistan, India, and China – all armed with nuclear weapons – skirmishing at their borders over refugees, access to shared rivers, and arable land.”⁴ In 2002, Norman Myer conjectured that climate change would create as many as 200 million “climate refugees” seeking shelter both within and across the borders of increasingly fragile states.

These statements may have helped catalyze interest in climate change as a security threat, but they are of little practical use for policymakers, who require much more specific statements about how climate change might affect political stability and the mediating factors that heighten a country’s vulnerability to climate-related violence. Moreover, Schwartz and Randall’s focus on interstate war among nuclear-armed powers may have focused attention on forms of conflict – major war – that are not an accurate reflection of the types of security challenges climate change is likely to pose. This overly narrow, state-centric definition of conflict fails to capture potentially impactful events like the widespread ethnic rioting that followed the flawed 2007 elections in Kenya, Muslim-Christian violence in Nigeria, and conflict between Lendu farmers and Hema pastoralists in the Democratic Republic of Congo, that has claimed well over 8,000 lives and led to the displacement of thousands more.

Thus, predicting, preventing, and responding to climate-fueled instability in Africa requires more than the traditionally narrow focus on armed conflict, which emphasizes primarily military solutions. A broader understanding of conflict requires economic and diplomatic efforts to resolve social unrest and promote the peaceful resolution of disputes to prevent longer-term crises and state failure.

Project Purpose

The primary purpose of this project has been to generate sound, peer-reviewed research on the way climate change – primarily operating through transient climatic shocks and food prices – will affect patterns of conflict and cooperation in Africa. A secondary purpose has been to advance data collection efforts on less severe forms of conflict, as well as advance the scientific understanding of event data validation. A tertiary purpose has been to translate these findings into more easily disseminated/policy relevant publications, blog posts, and direct interaction with policymakers in order to ensure that the information generated by the project is useful for planning purposes.

Study Design/Approach

In general, the various studies conducted by this team followed a similar format, with a literature review framing the problem, a theoretical discussion leading to testable hypotheses, followed by rigorous quantitative analysis. Many of the studies investigate the impacts of climatic variability – in particular, levels of rainfall relative to historic trends – on conflict outcomes.

Because the studies use somewhat different variables and statistical techniques, they are discussed sequentially.

1. Cullen S. Hendrix and Idean Salehyan, "Climate Change, Rainfall, and Social Conflict in Africa," *Journal of Peace Research* 49, 1 (2012): 35-50.

This study uses the Social Conflict in Africa Database (SCAD) – a data product generated by Salehyan and Hendrix as part of the CCAPS project – in order to assess the impacts of rainfall on social conflict in Africa. It argues that extreme deviations from normal rainfall patterns may lead to forms of social and political disorder (social conflict) short of civil war. Some forms of politically motivated conflict, such as protests and riots, do not require the high levels of organization or funding typical of armed rebellion. In addition, individuals and groups competing for resources may fight directly rather than engage the government, which is often far riskier given the state's preponderance of coercive force. Often times, groups will find neighboring communities, rather than the government, the most appropriate target for making demands; this is especially true if the state is known to be unwilling or unable to redistribute resources in a society.

Deviations from normal rainfall patterns are expected to affect social conflict through five mechanisms: First, rainfall deviations may lead to conflict among consumers of water, including those who depend on water as an input for their products. Second, both excess (i.e. flooding) and shortages of water can lead to price disputes between rural producers and urban consumers. Third, as livelihoods in affected areas come under stress, many will opt to migrate to urban areas in search of alternative work, potentially leading to migrant-host group friction. Fourth, extreme weather events can have particularly pronounced effects for public finance, reducing revenues available for investment in providing social services and patronage, leading to grievances. Finally, rainfall variability can have negative macroeconomic effects that generate widespread grievances in the population. These mechanisms point to a curvilinear relationship between rainfall and social conflict, with social conflict more prevalent during periods of water scarcity and water abundance relative to "normal" conditions.

The study uses both time-series cross-sectional (TSCS) and fixed effects estimators to recover the effect of rainfall deviations on conflict outcomes. TSCS techniques leverage variance both over time (i.e., comparing Liberia in 1995 to Liberia in 2003) and across countries (Liberia in 2003 to Guinea in 2003) to model outcomes (in this case, counts of social conflict events; see description of Salehyan et al. 2012). The key independent variable of interest is rainfall deviation (in later studies, referred to as rainfall anomalies).

Rainfall deviations are operationalized as deviations from the long-term means for a given country, normalized by the panel's standard deviation to account for the fact that different countries experience different mean levels of rainfall and rates of variability, and range from – 3.74 to 3.91. This measure more accurately accounts for cross-sectional differences in both mean values for rainfall, which range from 3.1 cm/yr (Egypt) to 233.3 cm/yr (Sierra Leone), and within-panel variance, measured by the variation coefficient, which ranges from 0.05

(Democratic Republic of Congo, low variability relative to the mean) to 0.27 (Botswana, high variability relative to the mean).

The study comes to two major conclusions. First, civil conflict—defined as active insurgencies that generate 25 or more battle deaths in a given year—exhibits a positive, linear relationship with rainfall. As rainfall increases, civil conflict becomes more likely, which runs directly counter to the popular narrative that drought increases armed conflict. A subsequent paper (see below) examines this relationship more closely. Second, the study finds that there is a curvilinear, U-shaped relationship between rainfall deviations and social conflicts such as protests and riots. Both extremes—too much and too little rainfall—make social conflict more likely. Moreover, when looking at violent social unrest, the substantive impact of too much rainfall, which can lead to flooding and crop damage, is far greater than that of drought, in which people typically have more time to plan and adjust. Therefore, rainfall variability and unpredictability—one of the key consequences of climate change—can be a significant driver of social disorder, protest, and political instability.

2. Idean Salehyan, Cullen S. Hendrix, Jesse Hamner, Christina Case, Christopher Linebarger, Emily Stull, and Jennifer Williams, "Social Conflict in Africa: A New Database," *International Interactions* 38, 4 (2012): 503-511.

One of the key contributions of the CCAPS project has been to develop theories and empirical models of the climate change-conflict relationship, across different types of political instability. Before embarking on this project, the academic community had several long-standing, methodologically sound indicators of armed insurgencies and civil war events. However, political instability can take on many different forms such as non-violent protest campaigns, riots, strikes, sporadic attacks against government forces or rival communities, and intra-governmental fighting. These types of unrest had been understudied. From the Arab Spring protests in Egypt and Tunisia, to electoral violence in Kenya, to communal conflicts in Nigeria, these forms of unrest are often no less significant in terms of their potential to destabilize states and alter the geopolitical landscape. Moreover, in understanding the potential impact of environmental disasters on conflict, a narrow focus on armed conflict would potentially ignore destabilizing events that do not involve organized insurgent groups.

Therefore, Hendrix and Salehyan set out to collect new data on social conflicts, which do not meet conventional definitions of civil war. Using searches of online news archives from the Associated Press and Agence France Presse, researchers identified over 10,800 social conflict events across all countries in Africa (with a population of 1 million or greater) between 1990 and 2013. These events include significant acts of non-violent protest (e.g. Arab Spring protests in Tunisia); incidences of riots (e.g. election riots in Kenya); labor strikes; government-initiated repression; small-scale anti-government attacks; extra-governmental or communal conflict; and intra-governmental fighting (coups and mutinies). Each event in the dataset contains information on dates, type of conflict, the actors and targets involved, the number of participants, the number of deaths, the use of government repression, locations (with geographic coordinates), and the issues involved, along with a brief description of the event.

Attesting to the significance of the project, the data have been incorporated in over 110 studies (as of 12/8/2014 according to Google Scholar) since its public release in 2012. The utility of the data is not limited to studying the climate change-conflict relationship, but can be applied to a wider range of questions including electoral violence,⁵ food price shocks,⁶ and the diffusion of conflict across borders through the use of information technology.⁷ Therefore, while the CCAPS research team has utilized the data to assess climate impacts on conflict, the data will continue to be used for years to come for a host of different studies.

Moreover, the data have been downloaded over 3,000 times by analysts in 90 countries. While the majority of these downloads have come from the U.S., a significant number originate from Europe and Africa. Moreover, while the bulk of data downloads have been among academic institutions, SCAD is also being utilized by governmental and non-governmental institutions. Among these are the World Bank, USAID, the U.S. Department of Defense, the Potsdam Institute for Climate Impact Research, Niger's Department of Foreign Affairs, and Nigeria's Environmental Ministry.

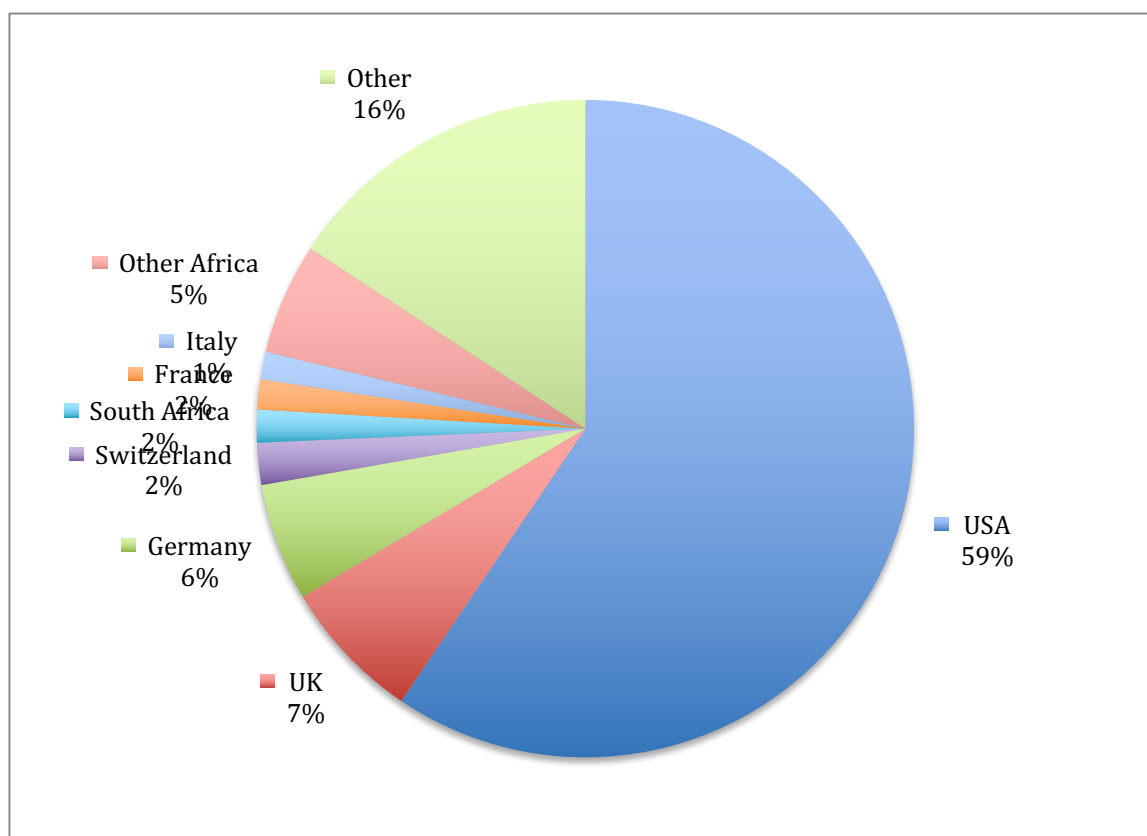


Figure 1: SCAD Downloads by World Region, 2011-2014.

In December of 2014, SCAD was re-launched as the Social Conflict *Analysis* Database. The data have been expanded to include coverage for Mexico, Central America, and the Caribbean using the same data generating procedure.⁸ Although the original grant proposal did not envision covering additional parts of the world, demand for expanded coverage has been high. Moreover, this addition will allow the research team to compare Africa with another important geopolitical

region to ascertain commonalities and differences across contexts. Although the project is now coming to an end, the availability of SCAD data for Latin America and Africa will enrich the academic and policy communities for years to come.

3. Idean Salehyan and Cullen S. Hendrix, “Climate Shocks and Political Violence,”
Global Environmental Change 28 (2014): 239-250.

This study focuses on the relationship between climate variability and armed conflict, defined as full-scale civil wars and insurgencies as well as terrorist campaigns. As opposed to social conflicts, which require little formal organization and resource commitments, armed conflicts typically involve highly organized actors who are committed to using violence to achieve political objectives. There are critical differences between sporadic social unrest and organized, armed conflict. First, armed conflict requires long-term planning and organization, leadership, and commitment by professional militants. Second, armed conflict requires resource inputs for financing rebel operations, and importantly, sustained contributions (voluntary or coerced) of food, water, shelter, and other supplies necessary for maintaining a rebel army. By contrast, protests, riots, and sporadic social unrest are typically short in duration and do not require long-term resource or time commitments.

Because of this difference, it is argued, rebel organizations face considerable difficulties in mobilizing for violence when resources are scarce. Thus, in contrast to much of the literature, which argues that drought leads to scarcity, resource competition, and violence, this article argues that militant activities will decline under conditions of drought. Rebels, insurgents, and terrorist groups will find it harder to secure resources—especially food and water—from the civilian populations when rainfall is scarce.

This argument is tested using data on all countries of the world from 1970 to 2006. Four different data sources on political violence are employed: the (binary) incidence of armed conflict from the Uppsala University Armed Conflicts Dataset (ACD); the number of battle deaths in armed conflict (ACD); the count of terrorist attacks from the Global Terrorism Database (GTD); and the number of terrorism-related fatalities (GTD). Environmental shocks are operationalized by annual, country-level deviations from mean levels of rainfall as well as the Palmer Drought Severity Index, which aggregates rainfall, temperature, and soil moisture. Thus, the hypotheses are tested against a wide range of climate and conflict data, ensuring that the results are not an artifact of data choices. The study uses both fixed effects modeling with temporal controls and multilevel random effects models in order to bridge a growing schism between methodological approaches in this area of inquiry.⁹

The study demonstrates that counter to the dominant discourse which links drought to violence, armed conflicts and conflict severity decline as agro-climatic conditions deteriorate. Conflicts are more likely when conditions are more conducive to agricultural production. In addition, this effect is far more pronounced in countries that are dependent on agriculture for a large share of GDP; in poorer countries; and in Africa and Asia. In other words, industrial economies are not sensitive to climatic shocks in driving armed conflict. This finding suggests that economic development and modern agricultural practices can help to reduce the potential for climate events to contribute to unrest.

4. Idean Salehyan, “Climate Change and Conflict: Making Sense of Disparate Findings,” *Political Geography* 43 (2014): 1-5.

CCAPS researcher Idean Salehyan served as guest editor for a special issue of the journal *Political Geography* on climate change and conflict. In this introduction to the special issue, he summarizes the literature to date and emphasizes points of debate. In general, the literature is marked by disparate findings on the relationship between environmental variables and conflict. Some find that climatic variables have a large impact on conflict; some find none at all; while still others find highly contingent effects. Much of this discrepancy is due to difference geographic units (local, national, global), time scales (months, years, centuries), and types of conflict (protests, civil conflict, interstate war) used by various studies, making it difficult to compare across them. Different research designs are ultimately a good thing, but analysts should be careful in making claims that their study is not designed to test. He notes that often data and theory do not match one another well and that researchers should take care to ensure that the data they employ are designed to test the specific questions posed. Moreover, rather than overly broad generalizations about climate change leading to conflict, scholars should be more nuanced with the claims they make with regards to the type, location, and temporal dimensions of conflict.

5. Colleen Devlin and Cullen S. Hendrix, “Trends and Triggers Redux: Climate Change, Rainfall, and Interstate Conflict,” *Political Geography* 43 (2014): 27-39.¹⁰

While the primary focus of this grant has been to study the effects of climate change for domestic political stability, the team also investigated its effects for interstate conflict. This study, co-authored by Cullen Hendrix and former William & Mary undergraduate student Colleen Devlin, focuses on the effects of rainfall on interstate conflict. It argues that interstate conflict over water resources is most likely in shared river basins, in which surface freshwater is shared between two or more states. In these cases, river water constitutes a common pool resource whose consumption is rival: one country's increasing consumption necessarily leaves the other country(ies) with less, potentially sparking distributional conflicts. Whether due to technological differences, the physical positions of actors relative to renewable freshwater resource, or economic resources, differential access to water resources has been a source of conflict in contexts as varied as the Colorado River basin, the U.S. Great Lakes region, the Middle East, and East and Southeast Asia. Climate change has the potential to exacerbate existing water resource competition.

This study distinguishes between the impacts of trends in rainfall patterns – mean levels, which proxy general aridity, and variability around that mean – as well as short-term trigger events: concurrent below-normal rainfall conditions in neighboring countries. In contrast to standard neo-Malthusian arguments, wherein less rainfall and concurrent below-normal rainfall should be associated with increased conflict propensity, the study develops a bargaining/contracting model of water sharing. In this model, variability in withdrawal needs from the shared river – as a function of rainfall variability – should be associated with more conflict. Counter intuitively, the model predicts that conflict should actually be less likely when both states experience concurrent drought conditions, as the opportunity costs to fighting are higher at times when government resources are needed elsewhere.

Hypotheses were tested via a re-analysis of two recent studies of conflict between co-riparian states, one by Jaroslav Tir and Doug Stinnett, one by Marit Brochmann and Nils Petter Gleditsch, with some modifications and extensions.¹¹ The unit of analysis for both is the dyad-year (i.e., Egypt-Sudan in 1991, U.S.-Canada in 2001). The analysis was restricted to the period 1950 to 2002. Tir and Stinnett's sample covers signatories of river cooperation agreements for the period 1950 to 2002, while Brochmann and Gleditsch analyze all dyads occupying the same continent. For this reason, the Brochmann and Gleditsch sample is much larger, though the availability of the precipitation measures restricts our sample sizes somewhat ($n = 72,583$ vs. $n = 5,774$). Conducting a reanalysis of both mitigates concerns that the findings are overly model- or sample-dependent. As with Salehyan and Hendrix, the study uses both fixed effects modeling with temporal controls and multilevel random effects models in order to bridge a growing schism between methodological approaches in this area of inquiry.

In this study, the dependent variable is militarized interstate disputes (MIDs) and fatal MIDs. MIDs are “united historical cases of conflict in which the threat, display or use of military force short of war by one member state is explicitly directed towards the government, official representatives, official forces, property, or territory of another state”.¹² Fatal MIDS are those MIDs that resulted in at least one fatality. The key independent variables of interest are 1) mean levels of precipitation within the dyad, which range from 0.6 dm (Egypt-Qatar) to 33.8 dm (Costa Rica-Panama); 2) within dyad variability in precipitation using the coefficient of variation¹³ for the dyad, and finally 3) joint precipitation scarcity, a dummy variable which takes on a value of 1 when both members of the dyad are experiencing drier than average conditions, i.e., those dyad-years in which both dyad member's precipitation levels are lower than their ten-year moving averages.

The study's main findings are as follows: First, MIDs and fatal MIDS are significantly less likely to occur when both members of the dyad are experiencing lower than average rainfall. Interestingly, this finding does not appear to be conditional on states sharing a renewable water resource. The finding is of similar magnitude in the Tir and Stinnett sample where all included dyads are parties to river management treaties, and thus by definition share a renewable water source. Second, evidence for the effects of mean levels of precipitation is mixed. The coefficients on dyadic mean precipitation are insignificant and close to zero in the Tir and Stinnett model, but strongly significant and negative in the Brochmann and Gleditsch sample: mean rainfall abundance has a pacifying effect on interstate relations – less arid countries experience less conflict. Finally, as precipitation variability in a dyad increases, conflict becomes more likely. Dyads characterized by more variable rainfall, a parameter expected to increase for most dyads under most climate change scenarios, experience more conflict. Curiously, these findings are not contingent on the countries sharing a river resource, suggesting they affect conflict outcomes through other mechanisms than competition over shared resources.

6. Cullen S. Hendrix and Stephan Haggard, “Global Food Prices, Regime Type, and Protest in the Developing World,” *Journal of Peace Research* 52, 2 (2015).

While most of the studies look at direct impacts of climate change on conflict outcomes, the team was also interested in how international markets might transmit weather shocks in one country or region around the globe. Local climate conditions in major exporting countries can

thus have dramatic effects on food prices continents away. In 2008, extended drought in Australia significantly constricted global supply, causing prices to skyrocket across much of Africa and Asia. Two years later, heat waves and wildfires in Russia led then-President Dmitry Medvedev to impose export restrictions on wheat, barley, and rye. This time, major importers in North Africa and the Middle East were hit hard, adding further fuel to the fire that bred the Arab Spring uprisings.

The rapid inflation in global food prices since 2000, and the acceleration of that increase in 2007–08 and 2010–11, has again raised the question of whether price shocks pose threats to political stability in the developing world. Protests and riots related to food prices took place in over 30 countries in 2007–08. The import-dependent Middle East witnessed food riots in Egypt, Jordan, Yemen, and Morocco. Demonstrations took place in Ethiopia, Burkina Faso, Senegal, Mozambique, Mauritania, Cameroon, Côte d'Ivoire, and Guinea. In Asia, people took to the streets in Bangladesh, India, Philippines, Cambodia, and Thailand. In 2010–11, food price-related protests recurred in several African countries including Algeria, Guinea-Bissau, Kenya, Libya, Mauritania, Mozambique, Senegal, Somalia, Sudan, Togo, and Uganda, as well as Bangladesh, China, and India.

CCAPS researcher Hendrix along with Stephan Haggard designed a study to assess the impacts of food prices on urban unrest in the developing world, with particular emphasis on Africa and Asia. While previous studies have focused on income as the primary factor affecting whether international prices will lead to domestic unrest, with poorer countries more vulnerable, the study counters that political institutions should matter a great deal, if not more. It hypothesizes that protests should be more frequent in times of high prices in democratic regimes, but that there should be essentially no aggregate relationship between food prices and unrest in authoritarian regimes. The mechanisms are two: 1) democracies have more open political opportunity structures: for any given grievance, the costs of mobilization will be lower; and 2) authoritarian regimes will be more pro-urban in their food policies, and therefore more likely to put in place policies that harm rural food producers but shield urbanites from high prices.

In this study, the dependent variable was a count of protests and riots in cities, with city-years being the unit of analysis. The study included 55 major cities in 49 mostly-developing Asian and African countries for the period 1961 to 2010. The dependent variable, protests and riots, is derived from the PRIO Urban Social Disturbance in Africa and Asia (henceforth USDAA) database.¹⁴ To model global food prices, it used the United Nations Conference on Trade and Development (UNCTAD) Food Price Index (FPI).¹⁵ In order to model the mediating variable – regime type – it relied on a tripartite regime coding (democracy, anocracy, autocracy) provided by the Polity project.¹⁶ To model urban bias in food policy, the study used the Estimates of Distortions to Agricultural Incentives data.¹⁷ The data reflect distortions to farm-gate prices arising from a number of policy interventions, including import and export taxes, subsidies, export quotas, domestic taxes or subsidies on farm outputs or inputs, and direct consumer subsidies for food staples. The variable, nominal rate of assistance (NRA), is the proportion by which government policies have raised (if $NRA > 0$) or lowered (if $NRA < 0$) returns to farmers above what they would be without the government's intervention. The data have a mean of 0.01 and range from -0.87 (Mozambique, 1975) to 2.26 (Republic of Korea, 2004), with lower values reflecting a greater degree of urban bias in food policy and higher values a greater degree of rural

bias in food policy. The study used a host of fixed effects estimators with differing approaches to addressing unit effects and heteroskedasticity in order to establish the robustness of the finding.

The main findings of the study are two: First, global food prices are robustly and positively associated with protest and rioting in democratic regimes, but not in autocratic ones (results are less robust for anocracies, the intermediate regimes where authoritarian and democratic tendencies co-exist). A one standard deviation increase in the food price index from its mean value is associated with a 35 percent increase in the frequency of protest and rioting in democracies. Second, some of this effect is due to lessened urban bias in democratic regimes. To the extent that global food prices are affected by climatic shocks and longer term trends – the Intergovernmental Panel on Climate Change (IPCC) predicts with medium confidence that food prices may rise as much as 84 percent by 2050 as a result of climate change, with increasing volatility and some risk of precipitous increases – this study provides evidence that it will affect urban unrest in the developing world through this mechanism. Moreover, it highlights the importance of context, as government policies can act (or not) to diminish the grievances associated with price shocks in international markets.

Other Related Research

The preceding six manuscripts represent the bulk of the team's work on the climate-conflict nexus. However, the resources and data provided by the team were also central in catalyzing several other studies, which are briefly discussed below:

1. **Idean Salehyan and Cullen S. Hendrix, "Science and the International Politics of Climate Change," *Whitehead Journal of Diplomacy and International Relations* 11 (2010): 27.**

This article addresses the gap between a broad scientific consensus on the hazards of climate change and limited action on the part of policymakers. Given that climate change poses a severe threat to ecosystems and to humanity, and that there is widespread scientific agreement about the problem, why has there not been more cooperation in crafting a comprehensive deal? The gulf is attributed to five factors: 1) politicized actors who remain skeptical that climate change is caused by human behavior, 2) the difficulty of forecasting human impacts, relative to physical impacts, 3) the global nature of the problem, which makes collective action especially difficult, 4) the diversity of actors with stakes in the issue, and 5) the time-inconsistency problem created by the fact that the most dire consequences will be felt by populations (the unborn) that do not have a say in current political debates. The article concludes with a discussion of the role the IPCC can play in better communicating the science of climate change.

2. **Idean Salehyan and Christopher Linebarger, "Elections and Social Conflict in Africa, 1990–2009," *Studies in Comparative International Development* (2014): 1-27.¹⁸**

Proponents of democratization often claim that liberal institutions have a palliative effect on the level of conflict within societies. Critics, however, suggest that the instruments of democracy, especially elections, can spark political violence, particularly in weakly institutionalized settings.

Using SCAD, this article examines the relationship between executive elections and social conflict in Africa for the period 1990 to 2009. It assesses the conditions that make elections more or less violent. It examines elections in: 1) countries faced with armed conflict, 2) post-conflict settings, 3) elections in autocracies, and 4) in relatively poor countries. It looks also at characteristics of elections themselves, including the margin of victory, the presence of observers, and allegations of vote fraud. Results show that while elections can sometimes spark violence, free and fair elections in genuinely democratic contexts are much less conflict prone, while illiberal elections are especially problematic. It does not find that current or recent armed conflict on a country's territory makes elections more violent.

3. Cullen S. Hendrix and Idean Salehyan, "No News Is Good News? Mark and Recapture for Event Data When Reporting Probabilities Are Less Than One," *International Interactions*, forthcoming.

This article discusses a common, but often ignored, problem in event data: underreporting bias. When collecting data, it is often not the case that source materials capture all events of interest, leading to an undercount of the true number of events. To address this issue, it proposes a common method first used to estimate the size of animal populations when a complete census is not feasible: mark and recapture. By taking multiple sources into consideration, one can estimate the rate of missing data across sources and come up with an estimate of the true number of events. To demonstrate the utility of the approach, it compares Associated Press and Agence France Press reports on conflict events, as contained in SCAD. It shows that these sources capture approximately 76 percent of all events in Africa, but that the non-detection rate declines dramatically when considering more significant events. It also shows through regression analysis that deadly events, events of a larger magnitude, and events with government repression, among others, are significant predictors of overlapping reporting. Ultimately, the approach can be used to correct for undercounting in event data and to assess the quality of sources used.

4. Cullen S. Hendrix and Idean Salehyan, "A House Divided: Threat Perception, Military Factionalism and Repression in Africa," Paper presented at the 2012 annual meeting of the Peace Science Society.

Why do governments in Africa repress certain contentious challenges but not others? This study adopts a blended approach to studying repression by taking seriously both the characteristics of contentious events as well as nature of the regime in power. This article argues that the more threatening a movement is—as measured by the use of violence, opposition demands, and targets—the more likely the state is to use repressive force. However, it relaxes the assumption that the state is a unitary actor, and allows for the preferences of state leaders and of the security forces to diverge when it comes to carrying out repressive policies. Countries with a history of factionalism in their security forces face an additional challenge: orders to crack down on protesters, rioters, strikers, etc., may not be followed or could even cause police and military forces to defect. It argues this potential is greatest when the challenge has ethnoreligious aims. It tests these propositions using SCAD, and finds significant support for the core theoretical conjecture: regimes with a history of past military factionalism are generally less likely to use repression. Such regimes are especially unwilling to repress ethnoreligiously based, ascriptive movements. These results are robust to several estimators that address the hierarchical nature of

the event data. These findings demonstrate the benefits of a blended, event-based approach to studying state repression.

5. Cullen S. Hendrix and Idean Salehyan, “Ethnicity, Nonviolent action, and Lethal Repression in Africa,” Paper presented at the 2014 annual meeting of the American Political Science Association.

When faced with popular protests and unrest, why do some governments respond with lethal force while others adopt a relatively more constrained response? This article argues that while states are expected to respond to violence with violence, regimes have different tolerances for peaceful mass mobilization events. Given the salience of ethnicity in African politics, ruling elites that depend on relatively small ethnic constituencies will see peaceful protests as more threatening, given that sizeable ethnic groups are excluded from power and can potentially be mobilized by the opposition. Governments that are based on broad ethnic representation, by contrast, are more secure in their rule and are more likely to tolerate peaceful unrest. These conjectures are tested using SCAD, and the study finds significant support for the core theoretical conjecture: regimes with more ethnically inclusive support bases are less likely to use lethal force against nonviolent challenges, while regimes with more narrow support coalitions are more likely to use repression.

Findings

The team’s research into the climate-conflict nexus has made five key contributions. First, it has demonstrated there is no single effect of climatic conditions on conflict; the effects are scale-dependent, both temporally (i.e., different patterns emerge when looking at short-term climatic shocks, such as drought, and longer-term, quasi-stable climate means) and with respect to different types of conflict. Short-term water scarcity, for instance, reduces violence in civil wars and terror attacks¹⁹ and produces more cooperative relations between states,²⁰ but increases nonviolent forms of contestation, like protests and strikes.²¹

Second, it has pushed the literature past simple, neo-Malthusian conjectures about scarcity and violence and refocused our attention on how climatic conditions might affect the costs and benefits of using violence to achieve strategic goals. That is, climatic conditions can influence conflicts that are in no sense “about” the environment. “Trends and Triggers Redux” developed a bargaining model that provided a unified theoretical framework for understanding how water scarcity might have differential effects of peace and conflict over the longer and nearer terms. In doing so, it has pushed the environmental security literature back toward the more established, theoretically nuanced literature on political violence.

Third, it has identified factors that mediate the climate-conflict link. In particular, the links are strongest for countries that are highly agriculturally dependent (agriculture as percentage of GDP), lower in economic development, and for the regions of Africa and Asia generally.²² This finding helps planners to focus their efforts on those countries that emerge as “most likely” cases for climate-related conflict and points the way toward policy interventions (a move toward manufacturing and services) that might break the climate-conflict link.

Fourth, it has identified a mechanism – global commodity markets – via which climate change and climate shocks may affect peace and stability in Africa, even if these shocks occur elsewhere. By now, there is a relatively large, though contentious, body of literature addressing the direct impacts of climatic conditions on conflict and political stability. Comparatively little is known, however, about how its effects will operate through other causal channels: higher food prices, more rapid rates of urbanization, both within- and cross-border migration of affected populations, declining revenues for affected governments, etc. This study demonstrates higher global food prices lead to more urban unrest in developing countries, with the effects largely concentrated in democratic regimes, and points again to the importance of contextual factors in mediating relationships between drivers and conflict outcomes.²³

Application of Results/Conclusions

For the policy community, the research conducted by the CCAPS team suggests that the link between climate change, environmental disasters, and conflict is quite nuanced. Blanket statements that climate change will or will not increase levels of unrest should be met with suspicion. Rather, analysts should take into consideration: 1) the time-scale under consideration; 2) the actors involved in conflicts; 3) the level of development and agricultural dependence in a society; and 4) what types of conflict are being examined. As such, in monitoring conflict hot spots and developing appropriate policies to deal with environmental stress, the following conclusions may be drawn:

- Climate change is more likely to lead to social unrest and violence in countries that are highly dependent on agriculture and that are relatively poor. While many African countries fit this description, not all do. Moreover, these categorizations fit numerous cases in Southeast Asia and Central America. Promoting long-term, sustainable development and modern agricultural practices can help to reduce the potential for hostile actions.
- Positive and negative rainfall shocks, relative to a country's average level of precipitation, have a significant effect on low-level social unrest such as protests, riots, and strikes. Anticipating irregular weather events and developing disaster relief and insurance mechanisms can help to reduce the risk of unrest.
- Armed insurgencies and terrorist campaigns are less likely and are less severe under conditions of drought. When resources are plentiful, counterinsurgency policies should attempt to weaken civilian collaboration with militant groups, which depend on contributions of food and water. Civilians should be protected from predation by security forces and be empowered to resist coercion by militants.
- Although regions that are relatively more arid are more prone to interstate conflict, drought tends to weaken state power and make disputes less likely. However, increasing rainfall variability will likely result in more frequent international disputes that typically do not escalate to war. As water resources become more plentiful, attempts to mediate international disputes should be strengthened.
- High food prices can lead to significant urban unrest in democratic countries, with potential effects for autocratic regimes at extremely high food prices, especially when these coincide with current account and trade deficits. Attempts to smooth food price

increases should be promoted at the global level through cooperative frameworks to manage volatility, such as increasing buffer stocks.

The U.S. has a unique role to play in helping to manage the human and national security implications of climate change. As major emitters of greenhouse gasses, the U.S. and other industrialized countries, are largely responsible for the climatic changes being witnessed today and that will undoubtedly be felt in the future. Unfortunately, these costs and risks will fall disproportionately on the poor, who are ill-equipped to adapt to rapid shifts in the climate and severe weather events. With its military and economic preeminence, the U.S. can play a positive role in helping to ameliorate the negative human impacts of climate change through playing a lead role in crafting global agreements; providing development assistance; responding to natural and man-made disasters; and providing technical help to countries in need. Ultimately, however, climate change adaptation and appropriate security policies will require deep cooperation at the local, national, regional, and international levels. The negative consequences of climate change are already being felt and are likely to intensify if such cooperation is not implemented soon.

¹ UK Ministry of Defence, *Adaptability and Partnership: Issues for the Strategic Defence Review* (London: Controller of Her Majesty's Stationery Office, 2010).

² Ole Danbolt Mjøs, *Nobel Prize Presentation Speech* (Oslo: Norwegian Nobel Institute, December 10, 2007), http://nobelprize.org/nobel_prizes/peace/laureates/2007/presentation-speech.html.

³ Idean Salehyan, "From Climate Change to Conflict? No Consensus Yet," *Journal of Peace Research* 45, 3 (2008): 315-326.

⁴ Peter Schwartz and Doug Randall, *An Abrupt Climate Change Scenario and Its Implications for United States National Security* (Pasadena: Jet Propulsion Laboratory, 2003), 18.

⁵ Arthur A. Goldsmith, "Electoral Violence in Africa Revisited," *Terrorism and Political Violence*, Published online 28 May 2014.

⁶ Todd G. Smith, "Feeding Unrest: Disentangling the Causal Relationship between Food Price Shocks and Sociopolitical Conflict in Urban Africa," *Journal of Peace Research* 51, 6 (2014): 679-695.

⁷ Blake Garcia and Cameron Wimpy, "Does Information Lead to Emulation? Spatial Dependence in Anti-Government Violence," *Political Science Research and Methods*, Published online 23 September 2014.

⁸ An extension to the countries of the Arabian Peninsula will follow in early 2015.

⁹ Solomon M. Hsiang, Marshall Burke, and Edward Miguel, "Quantifying the Influence of Climate on Human Conflict," *Science* 341, 6151 (2013); John O'Loughlin, Andrew M. Linke, and Frank DW Witmer, "Modeling and Data Choices Sway Conclusions about Climate-Conflict Links," *Proceedings of the National Academy of Sciences* 111, 6 (2014): 2054-2055.

¹⁰ Co-authored with William & Mary undergraduate student who was a coder on the SCAD project.

¹¹ Jaroslav Tir and Douglas M. Stinnett, "Weathering Climate Change: Can Institutions Mitigate International Water Conflict?" *Journal of Peace Research* 49, 1 (2012): 211-225; Marit Brochmann and Nils Petter Gleditsch, "Shared Rivers and Conflict—A Reconsideration," *Political Geography* 31, (2012): 519-527.

¹² Daniel M. Jones, Stuart A. Bremer, and J. David Singer, "Militarized Interstate Disputes, 1816–1992: Rationale, Coding Rules, and Empirical Patterns," *Conflict Management and Peace Science* 15.2 (1996): 163-213.

¹³ Coefficient of variation for dyad $d = s_d/\bar{d}$, where s is the standard deviation of water scarcity for dyad d and is the dyad mean.

¹⁴ Henrik Urdal and Kristian Hoelscher, "Explaining Urban Social Disorder and Violence: An Empirical Study of Event Data from Asian and sub-Saharan African Cities," *International Interactions* 38, 4 (2012): 512-528.

¹⁵ UNCTAD. UNCTADStat (<http://unctadstat.unctad.org/EN/>). Accessed February 12, 2013.

¹⁶ Monty Marshall and Benjamin R. Cole, *Global Report 2011: Conflict, Governance, and State Fragility* (Vienna: Center for Systemic Peace, 2011).

¹⁷ Kym Anderson, Marianne Kurzweil, Will Martin, Damiano Sandri, and Ernesto Valenzuela, "Measuring Distortions to Agricultural Incentives, revisited," *World Trade Review* 7, 04 (2008): 675-704.

¹⁸ Co-authored with UNT PhD student who has been part of the CCAPS team since inception.

¹⁹ Cullen S. Hendrix and Idean Salehyan, "Climate Change, Rainfall, and Social Conflict in Africa," *Journal of Peace Research* 49, 1 (2012): 35-50; Idean Salehyan and Cullen S. Hendrix, "Climate Shocks and Political Violence," *Global Environmental Change* 28 (2014): 239-250.

²⁰ Colleen Devlin and Cullen S. Hendrix, "Trends and Triggers Redux: Climate Change, Rainfall, and Interstate Conflict," *Political Geography* 43 (2014): 27-39.

²¹ Cullen S. Hendrix and Idean Salehyan, "Climate Change, Rainfall, and Social Conflict in Africa," *Journal of Peace Research* 49, 1 (2012): 35-50.

²² Salehyan and Hendrix, 2014.

²³ Cullen S. Hendrix and Stephan Haggard, "Global Food Prices, Regime Type, and Protest in the Developing World," *Journal of Peace Research* 52, 2.

Chapter 4. Armed Conflict Location and Event Data Project

Clionadh Raleigh, University of Sussex

Executive Summary

Throughout CCAPS, the ACLED component of the project produced over 100,000 unique records of political violence and protest events, 51 different trend reports, several regional reports, explorations of new areas in vulnerability research, including complex emergencies, multiple academic pieces, including discussing the false relationship between rainfall and conflict in *Nature*, ‘ungoverned spaces’ in *Stability*, an analysis of East African climate and conflict variation in the *Journal of Peace Research*; the link between migration and conflict in *Global Environmental Change*; and the relationship between the physical environment and conflict in *International Interactions*.

ACLED and associated material are now the world’s most extensively used public, real-time Georeferenced data set for Africa used by the United Nations, World Bank, Mo Ibrahim Foundation, USAID, US State Department, US Military, UK Government, Irish Government, multiple country governments in Africa and development organizations around the world.

Introduction

In CCAPS, the ACLED component of the grant was tasked with data collection as well as analysis. Both were successfully delivered: ACLED is designed for disaggregated conflict analysis and crisis mapping. This dataset codes the dates and locations of all reported political violence events in over 50 developing countries. ACLED data are released on a weekly basis to enable real-time analysis of political violence patterns and trends. The research team at ACLED derive event data from a variety of sources including local, national and international news reports, reports from developing countries and local media, humanitarian agencies and research publications. ACLED also produces Conflict Trends reports that are monthly updates on political violence and conflict events in African states. They are based on real-time data, and compare current trends and patterns to historical dynamics in key focus countries. The target audience includes policy makers and development and humanitarian practitioners. Finally, ACLED researchers engaged in extensive analysis of the relationship between climatic shifts and conflict patterns.

Project Purpose

The intention of this research is to create a scaled, localized, robust and rigorous investigation of environmental security, and create a collection of locally sourced data that presents the most reliable political violence collection.

This research fills this gap through the design of the data and the modeling perspective. The ACLED team is composed of political geographers who address conflict and environment threats from a scaled, and initially, localized perspective.

The significance of this research is in investigating whether local level data produces different results to national or generalized data. This is a crucial point: climate is experienced locally, but often modeled in the long term, and over a large area.

Study Design/Methodology

Data collection

ACLED (Armed Conflict Location and Event Data Project) is designed for disaggregated conflict analysis and crisis mapping. This dataset codes the dates and locations of all reported political violence events in over 50 developing countries. Political violence includes events that occur within civil wars and periods of instability. The project covers all African countries from 1997 to the present, and South and South-East Asia in real-time.

ACLED is directed by Prof. Clionadh Raleigh (University of Sussex). It is operated by senior research manager Caitriona Dowd (University of Sussex). Andrew Linke is a consultant on the project (University of Colorado) while the data collection involves several research analysts, including Charles Vannice, James Moody, Daniel Wigmore-Shepard, Andrea Carboni and Roudabeh Kishi.

These data contain information on:

- Dates and locations of conflict events;
- Specific types of events including battles, civilian killings, riots, protests and recruitment activities;
- Events by a range of actors, including rebels, governments, militias, armed groups, protesters and civilians;
- Changes in territorial control; and
- Reported fatalities.

Event data are derived from a variety of sources including reports from developing countries and local media, humanitarian agencies, and research publications. Please review the codebook and user guide for additional information: the codebook is for coders and users of ACLED, whereas the brief guide for users reviews important information for downloading, reviewing and using ACLED data. A specific user guide for development and humanitarian practitioners is also available, as is a guide to our sourcing materials.

Data are available for public download from the data page. Data for all African countries are from January 1997 and are updated in real-time. Real-time monthly ACLED data for African countries is available for download on this or the Climate Change and African Political Stability Project (CCAPS) website. For South and South-East Asia data, please contact Prof. Raleigh using the contact form on this website. Other data coded in the initial stage of this project is available from the data page, under 'Version 1'.

Maps and trend analyses of ACLED data are available in several locations and forms: real-time analysis of conflicts can be found on the ACLED Crisis Blog; trend reports which review monthly changes and patterns of political violence and are available on the Publications page; maps and graphics of real-time violence are available on the Visuals page; and in-depth research papers can be found on the Research page.

ACLED's aim is to capture the forms, agents, dates and locations of political violence and protest as it occurs within developing states.

ACLED Coding Methodology

Every event is coded using the same rules on who, what, where, and when, to maximize comparability and validity, thorough information. Additional information, such as event ID numbers, precision scores for location and time, notes to give the context of the event, fatality numbers if reported, codes to distinguish between the types of actors, and additional spatial information are also provided in each row of information. ACLED data are released in both excel and csv forms.

ACLED data are collected each week after individual coders have scrutinized the information from reports; they are then aggregated and revised by the first coding reviewer, investigated and cross-checked by the second reviewer and then event notes and details are inspected by the third and final reviewer. The process is designed to assure (1) validity through intra- and inter-coder checks; (2) accuracy to correct mistakes in coding; and (3) relevance by determining whether each compiled event constitutes an act of political violence or protest.

Below are a series of definitions and example codes that highlight the detail of each ACLED event.

Definition of Political Violence and Protest

Political violence is the use of force by a group with a political purpose or motivation. ACLED defines political violence through its constituent events, the intent of which is to produce a comprehensive overview of all forms of political conflict within and across states. A politically violent event is a single altercation where often force is used by one or more groups to a political end, although some instances – including protests and non-violent activity – are included in the dataset to capture the potential pre-cursors or critical junctures of a conflict.

We code nine event types including three types of battles, violence against civilians, remote violence, rioting (violent demonstrations) and protesting (non-violent demonstrations) and three types of non-violent events.

Battles are violent clashes between at least two armed groups. Battle types are distinguished by whether control of a location is unchanged as a consequence of the event; whether a non-state group has assumed control of a location, or whether a government has resumed control of that location. Battles make up approximately one third of the dataset.

Examples of Battles:

- Libya: Ghat residents and local forces repelled an attempt by Libya Dawn to take over the Ghat airport. Some 25 armoured vehicles carrying Libya Dawn forces were reported to have stormed the Ghat Airport on Friday night.
- Nigeria: Military forces launch an offensive on Boko Haram positions in Damaturu. A total of 14 soldiers were killed in action during the attack.
- Somalia: Two opposite clan militias hailing from Habar-Gedir/Sacad clashed in Galinsor village (30km NE of Cadaado) in the afternoon of 10/01. The two sides exchanged gunfire.
- Sudan: The SAF claims they killed between 41-100 rebel fighters (coded as 41) and took control of Angartu, near Kadugli, during fighting over the weekend, with assistance from the RSF.

- Pakistan: Pakistani paramilitary troops engaged with Balochistan Liberation Army militants in the Pirkoh area of Dera Bugti, Balochistan. 13 militants were killed on a gas field by troops backed by helicopters.
- Myanmar: Fighting flared between the Myanmar military and the SSA-South, with a member of the rebel group accusing government troops of staging an attack on its base in Shan State's Mauk Mae Township. No casualties were reported.

Violence against civilians involves violent attacks on unarmed civilians. These acts comprise a third of the collected data.

Examples of violence against civilians events:

- Nigeria: Two female suicide bombers, suspected as Boko Haram, detonated themselves up at a Yobe market (along Muhammed Idriss Way in Potiskum) after detonating bombs wired to their bodies, killing 39. The girls were said to be between 15 and 17-years-old.
- India: A Communist Party of India (Marxist) activist was hacked to death by Rashtriya Swayamsevak Sangh activists at Chukku Bazaar, near Thrissur district, on Sunday night.
- South Sudan: 8 people were killed in a revenge attack by Pagoor youth on Tieptiep payam in Cueibet county, allegedly due to the release of a Tieptiep clan member who killed one of the Pagoor community. 2 others were injured, including the paramount chief.
- Sudan: 3 villagers were killed in attacks on villages near Al Fasher by RSF militia-men. A number of people were wounded, 10 were abducted, and large numbers of livestock were also stolen.

Non-violent activity includes incidences of looting, peace-talks, high profile arrests, recruitment into non-state groups etc., and accounts for 6% of the total dataset.

Examples of non-violent events:

- Rwanda: Rwandan genocide suspect Jean Paul Birindabagabo is arrested and extradited to the ICC.
- Bangladesh: In an overnight raid in Chittagong, police arrested 82 activists of Jamaat-e-Islami and its student wing Islami Chhatra Shibir in addition to acquiring firearms and bullets.
- Nigeria: Police discover and dismantle a bomb targeting the Owerri Capital Development Authority (OCDA) office in Owerri, Nigeria.
- South Sudan: A peace conference has started in Mundri, South Sudan to resolve disputes between pastoralists and local farmers in the area following clashes which began in October 2014. (note: ACLED codes only the first announcement of ongoing peace talks.
- Chad / Nigeria: Chad has deployed a large military force, including at least 400 vehicles and helicopters, to assist Nigeria and Cameroon in their fight against Boko Haram. The vehicles arrived in Kousseri on Jan.17.

Non-violent takeover of territory is also under 1% of the dataset, as is headquarter or base establishment.

Examples of non-violent takeover events:

- Somalia: Al Shabaab forces take control of three Bay villages (Hagarko, Barbaare – near Qansadheer – and Buulo Barako) following the withdrawal of government forces.
- Libya: The Islamic State in Iraq and the Levant [Islamic State, IS, ISIS/ISIL] known by its [Arabic] acronym Da'ish, has officially announced the establishment of its branch in Libya and based in Benghazi.

Riots assume 7.5% of the dataset. A riot is a violent demonstration, often involving a spontaneous action by unorganized, unaffiliated members of society.

Examples of riot events:

- Burkina Faso: Rioters set fire to Truegold mining materials in Noogo. Police forces used tear gas to take control of the area while firefighters attended to the scene.
- Mauritania: After three anti-slavery activists received prison sentences, dozens of their supporters stormed the courthouse and smashed police van windows. Police used tear gas to disperse them, leaving four injured. Clashes between police and anti-slavery activists expanded from the courthouse to the civil prison area, causing closure of the city market. Rioters surrounded police vehicles and police used tear gas to disperse them.
- Algeria: Thousands of Algiers' inhabitants went out after the prayer on Friday to denounce the repeated attacks on Islam. Police intervened to disperse the demonstrators, who reacted by throwing stones and bottles. A few police officers were wounded.
- Nepal: Two student unions affiliated to ruling CPN-UML and main opposition UCPN (Maoist) clashed over the appointment of Campus Chief at Lainchour-based Amrit Science Campus. The students also vandalized the office of the Campus Chief.
- Bangladesh: Hartal supporters vandalized at least six vehicles and exploded several crude bombs in Paltan on Sunday morning. No injuries were reported. According to the police, the rioters were activists of Jamaat-e-Islami and its student wing Islami Chhatra Shibir.

Protests are non-violent demonstrations, involving typically unorganized action by members of society. They comprise 14% of the total dataset.

Examples of protest events:

- Sierra Leone: Health workers at the PTS I Hastings Ebola Treatment Center in Freetown protested against non-payment of their December hazard incentives.
- Zimbabwe: More than 200 villagers stage a demonstration at Masvingo Central Police Station against failure by Chiefs Musara and Chikwanda to resolve a boundary dispute. 8 of the demonstrators are arrested.
- Cambodia: More than 50 CNRP officials seeking the removal of lawmaker Ke Sovannaroeth as the party's head in Siem Reap province, demonstrated for two hours outside the opposition's headquarters in Meanchey district. The protesters accused Ms. Sovannaroeth of nepotism and spending irregularities.

- Thailand: Around 40 students rallied outside a military court in Bangkok, chanting slogans in support of four Thai men charged over an anti-coup protest and against the use of military courts to try civilians.

Remote violence refers to events in which the tool for engaging in conflict did not require the physical presence of the perpetrator.

Examples of remote violence events:

- Somalia: An RCIED detonated in the outskirts of Khadija Haji village (40km SW of Beled Xaawo) in the afternoon of January 8th. Reports indicate that the target was reportedly for SNG commander. The device seriously injured five civilians.
- Sudan: The SPLM-N has claimed the SAF bombed the area southwest of Kurmuk, killing 2 civilians and wounding 4 others, two seriously, between Jan.12-13. On Jan.13, the Shali area of Kurmuk was bombed specifically.
- Pakistan: Twenty-four militants were killed and five others sustained injuries when Pakistan Air Force fighter aircraft bombed their hideouts in Tirah Valley, Khyber Agency. Security forces targeted hideouts of the Tehreek-e-Taliban Pakistan and Lashkar-e-Islam in Dars Jumaat, Sandana, Takhtakai and Khyber Sangar in Tirah Valley.
- Bangladesh: A bomb was exploded at the Dhaka Metropolitan Magistrate (CMM) Court premises in the city on Thursday afternoon. The bomb was set off at the balcony in front of the courtroom. However, no one was injured in the incident. It is assumed that the BNP militia was behind the attack.

ACLED does not categorize clusters or campaigns of events, largely because political violence, protest and conflict are aggregations of multiple actors, attacks, goals, etc. To classify events as discrete acts in an ‘insurgency’ or ‘terrorism’, ‘civil war’ or ‘livelihood conflict’ is often a reductive choice, leaving out the complex ways in which conflict creates multiple scales of violence and intended outcomes within a territory. ACLED allows users to select on the type of event, type of actor, type of interaction, named actors, location or time period. We do not dictate nor frame a series of conflict events for researchers, but allow users to determine how to aggregate as they see fit.

Actors

ACLED recognizes a range of actors including governments, rebels, militias, ethnic groups, active political organizations, and civilians. In ACLED, politically violent actors include rebels, militias, and organized political groups who interact over issues of political authority (i.e. territorial control, government control, access to resources, etc.).

Fatalities

ACLED does not have a fatality threshold for event inclusion; further, it reports fatalities only when a reputable source has relayed that information. It uses the most conservative estimate available, and will revise and correct the totals- upward or downward- when better information comes available.

Sourcing

ACLED collects information from a variety of primary and secondary sources. By aggregating local and international news sources using various databases, ACLED coders track reporting on events concerning political violence and protest in Africa and Asia. Coders use local, state, and international media sources to capture events ranging from protests to battles.

Difficult Cases

When confronted with difficult cases where the actors or types of violence are unclear, ACLED coders follow standard rules including 1) finding additional information; 2) how to code an event with multiple dimensions (e.g. a riot that turns into violence against civilians is not coded as two events, but as the ultimate event against civilians); and 3) discussing specifics with researchers to establish if precedents exist. If the event is closer to criminal violence, over political violence where political objectives are the goal, then it is omitted from the observations.

Below are some examples of common difficult cases:

- South Africa: Vigilante violence where two suspected witches are killed in South Africa by a vigilante group. These events are often predicated on the internal security arrangements within a community. For that reason, vigilante groups function in similar ways to communal groups, as they believe their role to be the delivery of justice, and their group to be the reliable security arrangements within a community.
- Kenya: Pokot cattle rustlers struck Namawanga village inhabited by members of the Luhya community and shot dead a local farmer before stealing three bulls from his home. In revenge, Luhya tribesmen hacked to death a Pokot man after they found him ferrying two passengers to Karnyarkwat market. The killing of the man sparked off protest from members of the Pokot community who thronged to Kapkoi market vowing to take revenge over the killing of their tribesmen.

Research Activities

In addition to the monthly real-time conflict collection currently underway, ACLED:

- a) Delivered real-time, verified data in weekly increments;
- b) Developed on-going and updated analysis of crises on the African continent using these weekly data (analysis, descriptions and raw data for on-going crises will be available directly from the ACLED team, and wider public engagement will be through the ACLED crisis blog);
- c) Continued monthly trend reports which detail how violence patterns have changed over time within and between countries.
- d) ACLED designed a system through which local reporting, and local reporters, will come to replace secondary sources as the main information sources. The intention is for this system to be implemented as funding become available for a large-scale local network of conflict reporters.
- e) ACLED produced a range of maps for the visualization of geo-referenced data. Maps available on the ACLED website include both static and dynamic maps which trace patterns in violence and violent agents over time and across particular violent spaces.
- f) In addition, through associations with various organizations including the US

Department of Defence, Peace Research Institute Oslo (PRIO), the World Bank, the Department for International Development (DFiD), USAID, UNOCHA and the United Nations Department of Peacekeeping Operations Situation Centre, ACLED provided data and reports, and/or produce a range of tailored products including guiding principles on conflict types and environments, and short research papers on conflict actors and regional violence clusters.

Articles and Reports

Fifty one trend reports have been produced and are available here:

<http://www.acleddata.com/research-and-publications/conflict-trends-reports/>

Over a dozen country reports:

<http://www.acleddata.com/research-and-publications/country-reports/>

The following are selected academic publications that make use of disaggregated conflict data:

Raleigh, Clionadh, Hyun Jin Choi and Dominic Kniveton. 2015. The Devil is in the Details: An Investigation of the Relationships between Conflict, Food Price and Climate Across Africa. *Global Environmental Change*, 32: 187-199.

Raleigh, Clionadh. 2015. Urban Violence Patterns across African States. *International Studies Review*, 17, 1: 90-106.

Dowd, Caitriona. 2015. Cultural and Religious Demography and Violent Islamist Groups in Africa. *Political Geography*, 45: 11-21.

Dowd, Caitriona and Clionadh Raleigh. 2013. Sahel State Political Violence in Comparative Perspective. *Stability: International Journal of Security and Development*, 2, 25: 1-11.

Raleigh, Clionadh and Caitriona Dowd. 2013. Governance and Conflict in the Sahel's "Ungoverned Space." *Stability: International Journal of Security and Development*, 2, 2: 32.

Raleigh, Clionadh and Dominic Kniveton. 2012. Come Rain or Shine: An Analysis of Conflict and Climate Variability in East Africa. *Journal of Peace Research*, 49, 1: 51-64.

Raleigh, Clionadh. 2012. Political Marginalization, Climate Change, and Conflict in African Sahel States. *International Studies Review*, 12, 1: 69-86.

Raleigh, Clionadh. 2011. The Search for Safety: The Effects of Conflict, Poverty and Ecological Influences on Migration in the Developing World. *Global Environmental Change*, 21, 1: 82-93.

Raleigh, Clionadh. Seeing the Forest for the Trees: Does Physical Geography Affect a State's Conflict Risk? *International Interactions*, 36, 4: 384-410.

Innovations

ACLED innovated in several ways including:

- a) Real-time political data collection

- b) Application to new areas and states (e.g. South Asia)
- c) Local monitoring system
- d) Integration of locally sourced material
- e) Mapping and graphing innovations

Findings

Through the use of ACLED data and analysis from the CCAPS project, the following significant findings are robustly presented:

- **There is not one conflict, or type of conflict within wars: looking at the** subnational variation and fragmentation of authority we can determine points of pressure and breakdown but also points of resilience
- **Climate change is one of many politically unsettling occurrences within developing states, and very common. There is little evidence to tie the politics and economics of climate change to conflict.**
- **Conflict areas are not anarchic, disordered or ungoverned:** institutions and forms of governance created by the conflict will persist and affect potential for future outbreaks
- **Civilians are not just victims:** solving conflicts is not just about elite settlements and political market places – different alliances can destabilise political pacts or offer entry points for conflict resolution
- **Peace does not necessarily follow conflict:** It is not about the causes of conflict but the identification of entry points for peace and stability
- **Securing states may not result in the security of people:** We must understand trade-offs through multi-level integrated analysis of local, national, regional and global
- **Domestic politics causes political violence:** stability is contingent upon the multiple groups in violence being understood within the contexts they emerged

Application

An estimated 1.5 billion people worldwide live in conflict-affected countries where repeated cycles of political and organized violence hinder development, reduce human security, and result in massive humanitarian suffering (World Bank, 2011). By 2015, over 50% of the world's poorest will reside in places beset by conflict and chronic violence; the same countries that experience repeated cycles of conflict are those failing to meet the Millennium Development Goals. There is a need to understand and develop responses to the patterns, dynamics, escalation and consequences of conflict patterns in latent, active and post-conflict environments.

Across Africa, the nature of violence is shifting to urban locations, competition amongst political elites, reactions to social, economic and environmental change, and increasingly embedded with criminal motives. A core challenge to conflict reduction is the design, targeting, delivery and assessment of efficient, effective, high-quality response operations in conflict-affected contexts. This is hindered by the absence of, and limited access to, reliable, timely and accessible data on political violence that is comparable across time periods and geographic contexts. These challenges for development require a real-time, comparable, thorough, disaggregated, geo-located conflict event data project to record, visualize and analyse conflict environments. ACLED provides systematically collected, longitudinal, local

and accessible data on political violence and gender-based violence for the visualization and analysis of conflict patterns. These data alone allow for analysis of the levels and dynamics of political violence in multiple contexts (e.g. pastoralist contests in Kenya, militant recruitment in Burundi, government control of territory in Somalia, state violence in Zimbabwe, and Islamist militancy in Nigeria); this information is crucial to the targeting, delivery and assessment of humanitarian assistance, including developing best practices and institutionalizing learning.

Reliable, real-time data on conflict locations and levels supports effective and safe coordination, early warning systems, logistics and communication across actors in conflict environments; supports the targeting of the most vulnerable communities and locations in conflict-affected contexts; provides measures of exposure to conflict and supports comprehensive program evaluations. Further, these data have been critical in addressing new conflict risks in academic research (e.g. complex emergencies, political militias, urban violence). Therefore, continued collection and analysis is a key deliverable for multiple communities of use, including conflict-affected governments.

ACLED has clearly made significant contributions to the study of conflict events in developing states. With over 100,000 individual events in the database, ACLED contains a wealth of information on political violence that is available to the public at no cost. In addition to being available for download and as a searchable database, ACLED produces monthly conflict trends reports to provide time-sensitive information and examine escalating and on-going conflicts in the region. The CCAPS program also displays ACLED data, along with CCAPS data on climate vulnerability and aid, on its online mapping tool so that policy makers and researchers can visualize issues related to climate change and security in Africa.

Conclusions

More work is required into the politics of climate change adaptation, local governance and the trends in local conflict movements to promote political causes.

Chapter 5. Constitutional Design and Conflict Management

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Executive Summary

The CDCM project explores whether and how constitutional reform could reduce political instability and violence in Africa, by addressing the question in three steps. First, case studies of seven African countries identify how at key turning points the domestic political institutions either mitigated – or exacerbated – violent outcomes. Second, an unprecedented database of constitutional design in all of Africa reveals that most countries on the continent have highly centralized political institutions, which many experts believe foster conflict. Third, these lessons are combined to develop policy recommendations for foreign aid to promote democracy and good governance in Africa. Counter-intuitively, the CDCM project does not recommend promoting radical constitutional reform to “accommodate” groups based on their identity, as favored by many academics, on grounds that it is too different from what currently exists and therefore could result in half-measures that risk exacerbating political violence. Instead, the project recommends promoting gradual reform of Africa’s existing, centralized constitutional designs by counter-balancing them with liberal institutions, especially the separation of powers, which could foster both peace and democracy on the continent. The project’s complete findings and recommendations were published as a book: Alan J. Kuperman, ed., *Constitutions and Conflict Management in Africa: Preventing Civil War through Institutional Design* (University of Pennsylvania Press, 2015).

Introduction

Can deadly internal conflict be prevented, or at least significantly reduced, by changing a country’s domestic political institutions? This might seem an obvious and important question, especially for Africa, which recently has suffered the most such violence – in Rwanda, Congo, Darfur, and elsewhere. Yet, this continental puzzle has never before been addressed in a rigorous, comparative manner.

This project is the first such effort. As with any initial attempt to address a question of such enormous scope, the methodological challenges are substantial and the findings can be only tentative – but they are nevertheless intriguing. The project approaches the subject in three steps. First, it assembles seven of the world’s leading experts on constitutional design, conflict management, and African politics. Each of these scholars presents a detailed case study of an African country, identifying how at key turning points the domestic political institutions either mitigated – or exacerbated – political instability and violence. These studies provide vital lessons about the types of domestic political institutions – or “constitutional design” – that are best for peacefully managing conflict. Second, the project presents the first database of constitutional design in all African countries. This new resource reveals that most African countries have highly centralized and integrative political institutions, which many experts previously have said fosters conflict. Third, the project brings together these two pieces of the puzzle – comparing the

political institutions that Africa currently has to the type that might reduce violence – to develop policy prescriptions for foreign aid aimed at promoting democracy and good governance.

Counterintuitively, the CDCM project does not recommend promoting the constitutional design typically prescribed by academics for ethnically divided societies – which is based on decentralization and other explicit accommodation of ethnoregional groups – because it would be too different from what currently exists. Attempting such radical change, the project argues, would likely result in half measures that could backfire by exacerbating political instability and violence, contrary to their intent. Instead, the project recommends promoting gradual reform of Africa’s existing, integrative constitutional designs by counterbalancing them with liberal institutions – especially the separation of powers, including a strong parliament, independent electoral commission, and judicial review. The case studies and database suggest that such evolutionary reform of constitutional design could both promote democracy and reduce the incidence of political instability and deadly conflict in Africa. The project’s complete findings and recommendations were published as a book: Alan J. Kuperman, ed., *Constitutions and Conflict Management in Africa: Preventing Civil War through Institutional Design* (University of Pennsylvania Press, 2015).

Project Purpose

The previous relevant scholarly literature can be broken into three categories: comparative African studies, comparative global studies, and specific African studies.¹ In the first category there is one, relatively old, comparative statistical analysis of African countries, suggesting that parliamentary systems of proportional representation may reduce conflict in multiethnic states.² However, the only qualitative comparative studies of the continent, focusing on southern Africa, fail to reach consensus on that question.³

The CDCM project aims to engage the debate, among both academics and practitioners, regarding two opposing strategies of constitutional design.⁴ The first, “accommodation,” provides guarantees to societal groups based on their distinct identity or geographic location, via mechanisms such as proportional representation, federalism, autonomy, quotas, economic redistribution, and veto power. The opposing strategy, “integration,” aims to erode the political salience of groups that are distinguished by identity or location and instead promote a single, unifying nationality through more centralized institutions.⁵ The difference between the two approaches is not merely the degree of government centralization, but also the extent to which state institutions aim to reinforce or erode substate, ethnoregional identities.⁶ Between these two ideal-types, integration and accommodation, lies a spectrum of constitutional design strategies.⁷

Consensus is elusive on the best approach for conflict management. Arend Lijphart famously advocates the accommodation approach of “consociational” democracy that guarantees each major identity group a share of executive power, some autonomy, proportional representation and benefits, and a veto over fundamental decisions.⁸ Donald Horowitz criticizes such arrangements both for being inefficient and for reinforcing identity divides, and instead advocates “centripetalism,” the somewhat more integrative strategy of providing electoral incentives for political candidates to appeal across identity lines, an approach that might erode

such divisions over time.⁹ Lake and Rothchild criticize the specific accommodative approach of territorial decentralization on the grounds that it is an unstable outcome, destined to devolve into secession or reintegration, often entailing violence. By their reasoning, the integrationist approach of territorial centralization is the only stable alternative to secessionist dissolution of the state.¹⁰ Recent scholarship suggests that conflict management is best fostered by flexibility of constitutional design over time, a hypothesis that has yet to be tested rigorously.¹¹ Existing case studies of African countries provide a rich evidentiary base for future scholarship,¹² but to date they have lacked a common methodology, which is essential to drawing reliable and broadly applicable lessons.

Study Approach

Figuring out which constitutional designs are better or worse for conflict management in Africa is harder than might appear. At first, one might be tempted simply to examine the correlation between domestic political institutions and violence across the continent. This could be misleading, however, because African countries face a wide variation in the extent of the challenges they confront, so that some may remain peaceful not because of beneficial constitutional design but rather the good fortune of facing few stresses. Contrarily, other countries may succumb to violence despite beneficial domestic political institutions because they have the misfortune to be overwhelmed by events, such as the spillover of war from a neighboring country.

To control somewhat for this variation, and thereby increase the validity of comparisons between cases, the case-study authors agreed to focus on moments when each country faced particularly difficult challenges – “shocks” – and how constitutional design mediated the impact. The project does not aim to explain all domestic violence, but rather the role of constitutional design in mediating between shocks and the potential outcome of violence. In methodological terms, shocks are the “independent variable” that causes violence (the “dependent variable”), if not buffered adequately by constitutional design (the “condition variable”).

Shocks are defined by the project as relatively sudden – or more gradual, but especially large – changes that affect the distribution of resources and power in a country, whether arising from economic, political, demographic, or environmental dynamics.¹³ Each shock creates societal winners and losers, which scholars say can lead to violence via various mechanisms, including grievance,¹⁴ opportunities for predation,¹⁵ state weakness,¹⁶ or insecurity.¹⁷ The case studies explore how constitutional design interacts with such causal mechanisms to increase or reduce the likelihood of a violent outcome. Economic shocks include sharp changes in terms of trade, as well as resource windfalls or shortages. Political shocks include disputed elections, term-limit violations, land redistribution, assassinations, or other momentous political events – typically domestic but potentially foreign – that affect the distribution of power in the country. Demographic shocks include sudden migration flows and epidemics. Environmental shocks include floods, droughts, famine, and rapid environmental degradation.

Shocks can have complex causes and consequences. A shock may affect only one region of a country, but the results of that shock and the implications for constitutional design can

implicate the entire country. In some instances, a shock may lead to an outcome that serves as yet another shock, in a domino effect. In other cases, a single structural factor – such as poor governance, inadequate infrastructure, or economic dependence on a single export – may lead to multiple shocks over time. Constitutional reform, analyzed in this project mainly as a way to help buffer shocks, may also affect the structural factors that cause shocks.¹⁸

Admittedly, the CDCM project's common focus on shocks is an imperfect means of controlling for the magnitude of the challenge confronting each country's domestic political institutions, given the wide variation in the type and intensity of shocks. However, by focusing on shocks, this methodology does at least avoid lumping together data from easy and hard times – and thus represents a useful first step in aggregating and comparing the evidence between cases.

“Constitutional design” is defined by the project as the formal and informal structures of countrywide governance. Most obviously, this comprises institutions of integration and accommodation – including election rules, the nature of the executive, the extent of decentralization, and any guarantees to identity groups. It also includes the separation of powers – that is, provisions for the judiciary, legislature, or opposition to challenge the executive – and transitional justice for states emerging from autocracy or war. Additionally, it entails whether citizens accept the political institutions as legitimate, as well as any procedures for modification and interpretation of constitutional design, whether by courts, amendments, or informal pacts. The project examines not merely *de jure* institutions, but *de facto* implementation, finding that some codified institutions are not implemented, while other noncodified norms routinely are. This sheds important light on the need for and advisability of proposed reform of *de jure* institutions. This project's definition of constitutional design does not, however, include the historical evolution of political institutions prior to each case study, because the initial constitutional design is treated as an independent condition variable.

Rather than mechanically assessing each of the above elements, the case studies highlight the aspects of constitutional design that have the greatest mediating role – whether beneficial or deleterious – in each country. (For a summary of the shocks and outcomes examined in each case, see Figure 1.) The case studies also explore whether various elements of constitutional design interact with each other in ways that may alter their mediating effect. The project also recognizes that shocks may be mediated by factors other than constitutional design, including antecedent, proximate, structural, and individual characteristics in each country. Accordingly, the case studies report when such additional factors play an important mediating function, but the authors emphasize the role of constitutional design in accordance with the project's main research question.

To the extent possible, the project aims for detailed insight into the capacity and limitations of constitutional design to buffer shocks. It recognizes that such shocks vary along many dimensions, including rate of onset, magnitude, and duration. For example, a flood can arise in a matter of days, whereas desertification might take years to manifest but still would fit this project's definition of a shock. Some political institutions may be capable of buffering a gradually arising shock but not a sudden one, or a short shock but not a prolonged one. Moreover, constitutional design can mediate at various moments along the pathway from shock to violence. Some political institutions might prevent shocks from triggering rioting, while others

could inhibit a subsequent escalation from rioting to full-blown civil war. The case studies highlight such nuanced lessons wherever possible.

As the first rigorous study of its kind, this project faces formidable methodological challenges – regarding causal variables, outcome variables, endogeneity, omitted variables, selection effects, and degrees of freedom. In the future, as research expands and knowledge cumulates on the ways in which constitutional design may buffer or exacerbate shocks, such challenges should diminish. In the meantime, this project’s methodological choices, justifications, and implications are explained below.

Outcome Variables

The outcome that this project focuses on is peace, not democracy. While that focus is commonplace in the field of conflict management, it is not in the study of constitutional design. Accordingly, this choice may be controversial because, for example, it could lead to coding a peaceful dictatorship as a success, despite that outcome being antithetical to many. The project makes this choice not because peace is more important than democracy – nor because constitutions necessarily are designed mainly to promote peace – but rather because peace is a valuable outcome whose determinants should be understood. Democracy is also an important outcome, yet a genocidal democracy would be viewed by many as a failure. The project starts from the assumption that any potential trade-off between peace and democracy should be informed by rigorous social scientific analysis of the causes of each.

Coding the outcome of peace is qualitative and relative to a country’s history (see Figure 3). In some cases, the coding is obvious. For example, Burundi’s genocidal civil war starting in 1993 represents a failure, while Ghana’s decades without major political violence is a success. In other cases, coding is more nuanced and relies partially on counterfactual analysis of the plausible alternative outcomes for each country. For example, Sudan is not coded as a total failure after 2005 – despite subsequent fighting in its regions of Darfur, the Nuba Mountains, Blue Nile, and the secessionist South Sudan – because there has been no return of the genocidal wars fought between north and south until 2002 and in Darfur until 2004. Zimbabwe is coded largely as a failure after independence, in light of not only large-scale eruptions of killing – such as the massacre of 20,000 ethnic Ndebele in the 1980s – but also recurrent lower-level political violence. Senegal is coded mainly as successful, because urban protests and the attempted secession of Casamance have entailed little violence, yet the persistence of these disputes still represents a shortfall of conflict management. Kenya is coded as a partial failure because of its intermittent deadly riots surrounding elections, while Nigeria is coded as a somewhat larger failure because of the chronic nature of its ethno-political violence, including in the Niger Delta in the south and between Christians and Muslims in the north.

Causal Variables

The CDCM project codes “constitutional design” mainly along a spectrum from integration to accommodation in order to engage the above-cited debates among scholars and

practitioners about the types of political institutions that should be promoted in the developing world. As noted, the case studies assess these institutions not merely *de jure* but also *de facto* by looking at informal elements of constitutional design and the degree to which formal elements are implemented. The project regards constitutional design as a structural variable, but acknowledges that at times it can be modified or ignored, and thus may be viewed alternatively as a set of nonbinding norms that facilitate cooperation. In some instances, such as moments of military dictatorship, *de jure* constitutional design is effectively irrelevant, and the *de facto* design is coded most accurately, albeit imperfectly, as hyperintegration.

There exist many alternative ways to code constitutional design.¹⁹ For example, a substantial literature on African politics explores forms of patrimonialism.²⁰ Regimes have also been coded on scales from democracy to autocracy.²¹ Historical legacies have been explored by comparing the constitutions of former British, French, and Portuguese colonies. More recent scholarship assesses the inclusion and exclusion of ethnic groups from power.²² The malleability of constitutional design – that is, the ease or difficulty of reforming political institutions – may in some cases be more important than the institutions themselves. The effect of each of these variables on the capacity of states to buffer shocks is worthy of focused exploration, but beyond the scope of this project.

The CDCM project nominally labels constitutional design as an “independent” condition variable, because this project’s focus is on its mediating role between shocks and violence, but these relationships can be partially endogenous. Constitutional design is not applied to states as a random treatment, but rather evolves in part through self-selection. As illustrated by the case studies, constitutional design also can be both a cause and consequence of shocks, not merely a mediator of their impact. In some instances, there may be a spurious correlation between constitutional design and outcome, if both are caused by a third variable, such as interethnic animosities. Nevertheless, the case studies also confirm the mediating role of constitutional design, which has important implications for African countries contemplating institutional reform, and for international aid programs that promote democracy.

Shocks are categorized by this project into four groups: economic, demographic, political, and environmental. But they also could be differentiated by the extent of their endogeneity with constitutional design, into three categories.²³ The first type would be essentially exogenous, including extreme weather or sharp changes in world commodity prices. A second type of shock would result from the normal functioning of constitutional design, such as when a longtime incumbent loses reelection. The third type would stem from a violation of constitutional design – such as a coup, stolen election, or state violence. It is possible that the mediating role of constitutional design varies depending on the extent to which a shock is endogenous to that design, and this too could be explored in future research.

Other potentially important variables are excluded from this project’s theoretical model for the sake of parsimony, as is common in the early stages of any research field. For example, ethnic demography may condition the ability of constitutional design to mediate shocks.²⁴ If so, it is possible that accommodative designs, such as consociational democracy, could help to buffer shocks in states with two or three polarized ethnic groups, but would be suboptimal in other situations. Likewise, some constitutional designs may be more beneficial in the immediate wake of a civil war than during times of sustained peace.²⁵ Such questions could be explored in

future research by examining only shocks in states with accommodative constitutional designs, or only in the wake of civil war, and then investigating which other variables correlate with the variation in outcome.

Qualitative Method

If the project's methodology were statistical, it would confront hurdles stemming from "degrees of freedom." In other words, there would be too many potential explanatory variables for the relatively few outcomes to be explained. Constitutional design comprises more than a dozen components, and even the partially aggregated coding in this project's database includes five categories. Shocks are grouped into four categories but also vary further within each category by type and intensity. Yet, the case studies examine only seven countries, including the outcomes of just 20 shocks. No statistical method could overcome these challenges. It would be possible to further amalgamate some of the subcategories of constitutional design and shock, and to greatly expand the number of shocks under examination, but that could lump together disparate phenomena, creating more noise than signal and reducing the value of any inferences.

Pessimists might throw up their hands at these challenges, declaring that no lessons can be drawn to guide policymakers. Indeed, each of Africa's 53 countries (the total when the project's database was created) has a different constitutional design, faces different shocks, and is characterized by unique culture and history, so that facile generalizations should be avoided. But by moving beyond statistics, meaningful inferences are possible.

Qualitative methods are well suited for this project's research design. By employing the methodology of "process tracing,"²⁶ the case studies can identify with relative confidence the causal relationships between shocks, constitutional design, and violent outcomes. Even though no two shocks are identical, nor any two constitutional designs, qualitative methods can focus on the intervening variables, which may be quite similar. These include the sudden creation of societal winners and losers, the resulting demands on the political system, the capacity of the constitutional design to respond to those demands, and the consequences when constitutional design proves inadequate in this regard.

To help infer reliable lessons, the project deliberately picked case studies that provide variation on several key variables,²⁷ including the outcome (both comparatively between cases and longitudinally within cases), constitutional design,²⁸ and African subregion. Still, the project's findings are by no means the last word on constitutional design and conflict management in Africa. It is hoped that other scholars will evaluate and build upon the project's tentative findings, including by employing additional cases and methods. As detailed below, the project's first four cases illustrate that the constitutional design of accommodation – widely touted as a prescription for conflict management – is not without substantial risks in practice. By contrast, the last three cases suggest that the commonly denigrated constitutional design alternative, integration, may actually mitigate conflict under certain circumstances.

Findings

Burundi: Incomplete Accommodation May Backfire

The study by Filip Reyntjens contrasts Burundi's two attempts at accommodative constitutional reform to help mediate the shock of ending minority rule, which produced starkly different outcomes. The first attempt, in 1993, tragically led to civil war and genocide. By contrast, the second attempt, in 2005, appears so far to have promoted relative peace, equity, and ethnic reconciliation. In each instance, the constitutional design aimed to accommodate both the traditionally dominant ethnic Tutsi minority, by providing security guarantees and representation, and the historically oppressed ethnic Hutu majority by transitioning to democracy.

The case study finds three main explanations for the far superior outcome of the latter effort. First, the revised accommodative institutions offered firmer guarantees of representation to the ethnic minority. Second, a regional peacekeeping force helped reduce the physical security concerns of that minority. Third, sufficient time had passed since the initial reform effort for the ethnic minority to be reconciled to its loss of political dominance. Although the case thus confirms the beneficial potential of accommodation, it also highlights an important caveat – that accommodation by itself cannot mitigate intense group insecurity. Accordingly, transitions of power should be implemented gradually and accompanied by third-party security guarantees, rather than relying solely on accommodative domestic institutions.

Burundi also illustrates the counter-intuitive lesson that explicit acknowledgement of ethnic identity by government institutions can help reduce both the political salience of identity and the proclivity to interethnic violence. This may have important implications for neighboring Rwanda, whose government is attempting to mitigate a similar history of interethnic violence with the opposite strategy – denying the existence of group identities – which, unfortunately, seems to be heightening ethnic salience and tensions.

Kenya: Backsliding on Accommodation Perpetuates Electoral Violence

The study by Gilbert M. Khadiagala explores how, since the late 1980s, Kenya's constitutional design, characterized by partial accommodation, has failed to buffer four major shocks to its political system. The result of each shock typically has been midlevel violence, followed by only marginal constitutional reform, leaving the system vulnerable to the next shock. The shocks examined are as follows: 1) In the early 1990s, popular demands for a multiparty system, combined with donor aid cutbacks; 2) In the mid-1990s, violent riots and protests; 3) From 2003 to 2005, the combination of three successive tremors arising from the demise of incumbent parties and coalitions; and 4) In late 2007, accusations of a stolen election.

Three broad lessons emerge. First, the integrative aspects of the country's constitutional design, including a strong presidency, fostered and then failed adequately to buffer a series of economic and political shocks. Second, the constitutional design historically reinforced ethnic dominance, which contributed to a protracted national stalemate over that design. Third, endogenous and exogenous shocks eventually gave rise to a more substantial constitutional

reform in 2010, but the robustness of these modified institutions will not be revealed until they are tested by future shocks.

Nigeria: Federalism Requires More Devolution

The study by Eghosa E. Osaghae examines the effects of three shocks arising from petroleum extraction in the Niger Delta region of southern Nigeria. The first shock was the discovery of oil in the 1960s, which created a major revenue windfall that spurred secession by the Biafra region (including the delta), leading to civil war and massive civilian victimization. The second shock was the oil industry's pervasive environmental degradation that became politically salient in the 1990s, spurring a new rebellion. The third shock was the oil price spike of the 2000s, which magnified both the resources available to militants and their demands, thereby escalating the rebellion.

Nigeria's constitutional design has long contained elements of accommodation, notably federalism and requirements for diverse regional representation in government institutions. This case study demonstrates, however, that such limited devolution has proved inadequate to address local grievances about oil revenue sharing and environmental justice in historically neglected areas populated by ethnic minorities. Except for federalism, the Nigerian government is highly centralized in its executive, legislative, and fiscal institutions, while lacking the resources to manage complex issues in the periphery. Osaghae concludes that prospective reforms to increase revenue sharing and to devolve political authority to the community level may offer the best hope of reducing grievance and the resulting persistent rebellion in the Niger Delta.

Sudan: The Hazards of Inequitable Accommodation

Sudan's 2005 Comprehensive Peace Agreement (CPA), which successfully ended a long-running north-south civil war, represented a major constitutional accommodation to the country's south, including a pledge (subsequently honored) to hold a secession referendum after six years. The study by Karly Kupferberg and Stefan Wolff explores the two main shocks entailed by implementation of the agreement: first, in 2005, the sharing of power between adversaries who had fought each other for more than two decades; second, in 2011, the south's vote to declare independence. Both events satisfy the project's definition of "shock" – because they represent a sudden change in the balance of power and resources – so it is important to examine how the agreement's constitutional design mediated each. Although there has been no recurrence of full-blown war between the north and south, local violence has erupted, not only in the disputed border area of Abyei, but also in other areas of the north (Blue Nile and South Kordofan states) and the south (Jonglei, Unity, Upper Nile, and Warrap states).

The case study finds that the CPA's institutions to regulate core north-south issues did successfully foster compromise and peaceful management of conflict *between* the two sides, with assistance from international engagement. But the implementation of the CPA failed to establish political institutions to mediate interactions among the contending groups *within* each region,

thereby contributing to the outbreak of violence in both the north and south, some of which has been exacerbated by cross-border support to militants.

The case thus illustrates the dangers of *inequitable* accommodation. Although the 2005 agreement nominally pledged comprehensive reform, in practice it made significant concessions only to the most violent opponent of the government, while essentially ignoring other aggrieved groups. “Comprehensive” was thus a misnomer. The flawed design and implementation not only permitted the grievances of other groups to fester, but also aggravated them and encouraged these groups to resort to violence in hopes of earning similar accommodation. This experience suggests that accommodation must be equitable -- not merely on paper, but in practice -- if it is to buffer effectively against shocks.

Ghana: Liberal Institutions Mitigate Perils of Integration

The study by Justin Orlando Frosini explores how and why Ghana has remained peaceful in the face of repeated shocks, despite having a highly integrative constitutional design, which many scholars claim is suboptimal for conflict management. The four shocks under examination are the construction of the Volta Dam that displaced 80,000 people in the 1960s, and then the turbulent elections of 1992, 2000, and 2008, which entailed accusations of electoral fraud, boycotts by opposition parties, and the defeat of incumbent presidents. Although each shock produced some political conflict, none resulted in significant violence.

The beneficent effect of key individuals and culture cannot be excluded in Ghana, but several aspects of constitutional design also helped foster non-violent outcomes. Since 1992, for example, the president has been limited to two terms, thereby offering political opponents hope that they can accede to the top office peacefully, rather than having to fight for it. Although the government’s formal institutions are highly integrative, including first-past-the-post legislative elections, one informal aspect of constitutional design is highly accommodative – by tradition, cabinet posts and other executive positions are distributed to reflect the country’s ethnoregional diversity. This may produce a stabilizing effect similar to that attributed to formal accommodative institutions, such as quotas or proportional representation. Perhaps most important, liberal institutions – including free media, term limits, an independent electoral commission, and courts with the power of judicial review – provide a separation of powers that can check abuses by the executive. Facilitated by these factors, Ghana’s integrative institutions produce many of the benefits typically ascribed to centripetal constitutional design: namely, there is a two-party system in which politicians make cross-group appeals, coalitions are fluid, political power alternates between parties and among groups, and the political salience of group identity diminishes over time.

Senegal: Inefficiency of Hyper-Centralization

The study by I. William Zartman, Hillary Thomas-Lake, and Arame Tall explores how Senegal’s highly centralized constitutional design has mediated two shocks: rain-induced flooding that has produced widespread population displacement around the capital of Dakar; and

secessionist rebellion in the province of Casamance. It finds that the highly empowered office of the president has been able to take belated, unilateral action to address shocks superficially – thereby temporarily buffering their effects and averting large-scale violence – but has lacked the capacity for urgent action or for reform to address the underlying vulnerabilities. As a result, the country’s populace remains persistently susceptible to shocks, and thus moderately aggrieved, but has not yet resorted to large-scale, extrasystemic violence.

To provide better protection against shocks, such a hypercentralized constitutional design requires one of two types of reform. The first option is accommodation, such as devolving authority to local officials who could be more responsive to local concerns. The alternative would be liberal institutional checks on the executive, such as a strong legislature and independent judiciary, to foster greater accountability to constituents.

Zimbabwe: Exclusionary Authoritarianism Exacerbates Shocks

The study by Andrew Reynolds assesses how Zimbabwe’s increasingly centralized and authoritarian constitutional design over the past three decades has mediated the effect of three shocks on political stability and interethnic relations. At independence, the country’s constitutional design contained aspects of accommodation, both formal and informal, for minorities. The small White community was constitutionally ensured representation in the legislature and the protection of its property. The main Black minority ethnic group, the Ndebele, had during the preceding war of independence been effectively accommodated within the ruling party that was led by the ethnic majority Shona.

The first shock, in the early 1980s, was the emergence of violence between the government and its former allies, the ethnic Ndebele paramilitaries. The outcome was the Gukurahundi massacres by the state of an estimated 20,000 Ndebele in the region of Matabeleland, eviscerating the informal accommodation toward this minority. The second shock, in the year 2000, was the defeat of the regime’s constitutional referendum. The result was the Third Chimurenga – the seizure and occupation of White-owned farms – which led to a breakdown of law and order, out-migration of White farmers, economic decline, and the effective end of the formal accommodation of Whites. The third shock was the 2008 election victory by the opposition Movement for Democratic Change (MDC). This led to the regime’s violent suppression of the opposition (Operation Ngatipedzenavo), followed by a nominal power-sharing agreement that effectively reversed the electoral outcome.

The case demonstrates, most obviously, that exclusionary authoritarianism can only temporarily succeed at using force to suppress the domestic opposition, because the government’s violence exacerbates economic decline and other sources of unrest. Less obviously, the study reveals a potential silver lining. President Robert Mugabe’s three decades of increasingly exclusionary and oppressive rule have helped unite his opponents across ethnic lines to forge perhaps the most inclusionary political alliance in any African country, comprising Shona, Ndebele, and Whites. This offers some hope for a future political transition in Zimbabwe.

The study by Eliezer Poupko presents the first database of constitutional design in all of Africa's countries, coded on a spectrum from integration to accommodation. That coding is based on three separate but interrelated institutional dimensions – executive, legislative, and administrative – including both *de facto* and *de jure* measures at the start of 2011. The executive is coded as integrative if there is a directly elected president and otherwise is coded as accommodative, except in rare cases where additional executive elements provide substantial counterbalance. For example, vote-pooling in a direct presidential election would make the executive more accommodative, while appointment of the president by a majoritarian parliament would make the executive more integrative. The legislature is coded as most accommodative if the lower (or only) house is selected by proportional representation with sizeable districts and minimal thresholds for representation, and as most integrative if there is plurality voting in single-member districts. Adjustments are made for mixed voting systems, quotas, bicameralism, and the power of the legislature in relation to the executive. The administrative dimension is coded as integrative in a unitary state, and as accommodative to the extent there is federalism or devolution to subnational entities, especially based on identity.

Each country as a whole is coded as hyperintegrative or hyperaccommodative if all three institutional dimensions point in the same direction. If two of the three dimensions point in the same direction, the coding is integrative or accommodative. The remaining countries are coded as balanced. These *de jure* codings are then adjusted, based on implementation, to determine the *de facto* codings. For example, if a legislature is formally accommodative and empowered, but in practice is dominated by an integrative executive, the *de facto* coding of the legislature is switched to integrative, potentially altering the overall country coding. (As discussed above, important roles may also be played by informal or extraconstitutional domestic institutions – such as traditional authorities, norms of regional distribution, militaries acting as guardians of stability, or political parties cooperating outside of government – but these are difficult to code and so are not incorporated in the database, although they are in the case studies.) As illustrated by a summary of the database (see Figure 2), Africa has a strong tendency toward integrative constitutional design, as nearly 80 percent of countries on the continent are coded as integrative or hyperintegrative.²⁹ The two most common elements of such integration are directly elected presidents and centralized administrative structures that limit identity-based politics.

Application of Results

The broad lesson from the case studies is that neither of the two opposing constitutional approaches – integration or accommodation – is necessary or sufficient for buffering against shocks, but that each may achieve this goal if institutionalized appropriately. (Indeed, as illustrated in Figure 3, the two most successful constitutional designs in the case studies – Ghana and Burundi-2005 – lie on opposite ends of the integration-accommodation spectrum.) If implemented poorly, however, either approach can leave a society highly fragile to shocks, which may trigger instability up to and including civil war and genocide. For each of the two approaches to constitutional design, the sources of fragility and the requirements of “appropriate” institutionalization are different, as discussed below.

The main danger of integration is that it tends to concentrate power in the hands of an executive that may be unaccountable, and therefore insufficiently responsive, to large segments of society. This can breed grievance among the neglected population, compelling the executive to rely on an even narrower base, which further exacerbates societal resentment, leading to an escalatory spiral. In such a situation, a shock can magnify grievance and create opportunities for offensive or preemptive violence by the government or its domestic opponents. Five of the seven cases – Kenya, Nigeria, Senegal, Sudan, and Zimbabwe – illustrate that pathology.

This hazard of integration can be mitigated in two very different ways, according to the case studies. One option is to promote accommodation, which runs substantial risks as detailed below. The other option is exemplified by Ghana, which balances its integrative design and strong executive with liberal institutions – including term-limits, courts with the power of judicial review, an independent electoral commission, and media freedom – which offer reassurance to the political opposition about a peaceful path to power.³⁰ In the context of these complementary liberal institutions, the country's integrative electoral mechanisms – including first-past-the-post elections – encourage cross-group appeals by politicians who cannot gain sufficient votes for victory from their own ethnic group alone. This also promotes fluid pre-election coalitions among societal groups as they aggregate into the two main political parties. Both dynamics help erode identity divisions and further encourage the expectation among opposition groups that they eventually can gain power through political rather than violent means, thereby promoting a virtuous rather than escalatory spiral.

The other option, accommodation, is the more obvious constitutional strategy for conflict management, because it addresses grievance through direct appeasement. This can work, but entails risks of backfiring gravely if not institutionalized appropriately. Three of the seven cases – Burundi, Kenya, and Sudan – illustrate the potential of accommodation. Burundi greatly reduced persistent interethnic tension and recurrent violence, and even the salience of identity, by accommodating both the Hutu majority and Tutsi minority in its 2005 constitution, providing guarantees and protections for each. Likewise, Kenya broke its cycle of election-related, inter-tribal violence – at least for one national vote in 2012 – by adopting accommodative constitutional reforms in 2010. Sudan successfully ended decades of north-south civil war in 2005 by accommodating the south with a 2011 referendum on secession.

But two of these cases also illustrate the dangers of poorly implemented accommodation. Burundi, in its first attempted transition to democracy in 1993, made the error of accommodating the ethnic majority too quickly, without adequate protection or socialization of the traditionally dominant ethnic minority. The tragic result was that the minority resorted to lethal force to retain its security and prestige, culminating in genocide and civil war. The lesson is that accommodation should be pursued in an evolutionary rather than revolutionary manner, providing sufficient time and security guarantees to enable traditionally dominant groups to overcome their psychological obstacles to surrendering power.

Sudan made the error of accommodating only the country's best-armed opposition groups, in the south, by permitting a secession referendum in that region. This not only failed to accommodate other aggrieved groups in the north and south, but encouraged them to view

violence as the path to accommodation. The consequence has been an escalation of civil war and civilian victimization in both rump Sudan and South Sudan. The lesson is that accommodation should be institutionalized in an equitable rather than selective and discriminatory manner, if it is to provide a buffer against shocks.

Conclusions/Recommendations

Given that most African countries have highly integrative constitutional designs – which leave them susceptible to shocks – foreign aid to promote democracy and good governance could follow either of the two strategies identified above. One option would be to promote a radical transformation of domestic institutions from integrative to equitably accommodative. The alternative would be to promote only marginal changes in constitutional design by complementing the existing integrative institutions with liberal elements – such as term limits, empowered legislatures, media freedom, and independent courts and electoral commissions – to counterbalance and thereby mitigate the pathologies of strong executives.

In theory, either pathway could work. In practice, however, it is difficult for outsiders to induce major changes in a country's constitutional design, due to countervailing dynamics of culture, politics, resistance to perceived neo-imperialism, and historically rooted path dependency.³¹ As a result, foreign pressure to adopt full accommodation could well result in only partial reform that is inequitable or provides inadequate guarantees to insecure groups, raising the grave risks illustrated by Burundi and Sudan (see Figure 4). Accordingly, aid donors should consider instead promoting liberal reforms of Africa's existing, integrative constitutional designs – rather than their radical replacement with accommodative designs – despite the general academic preference for the latter, if they wish to foster both peace and democracy in Africa.

Endnotes

¹ For more detail, see Eli Poupko and Alan J. Kuperman, *Selected Annotated Bibliography: Constitutional Design and Conflict Management* (Austin: Robert S. Strauss Center for International Security and Law, 2011).

² Shaheen Mozaffar, "Electoral Systems and Conflict Management in Africa – A Twenty-Eight State Comparison," in *Elections and Conflict Management in Africa*, eds. Timothy D. Sisk and Andrew Reynolds (Washington: U.S. Institute of Peace, 1998): 81-98. However, the findings on proportional representation are not as clear in Shaheen Mozaffar, James R. Scarritt, and Glen Galaich, "Electoral Institutions, Ethnopolitical Cleavages, and Party Systems in Africa's Emerging Democracies," *American Political Science Review* 97, 3 (2003): 379-390.

³ Joel D. Barkan, "Rethinking the Applicability of Proportional Representation for Africa," in *Elections and Conflict Management in Africa*, eds. Timothy D. Sisk and Andrew Reynolds (Washington: U.S. Institute of Peace, 1998): 57-70; Andrew Reynolds, "Elections in Southern Africa – The Case for Proportionality, A Rebuttal," in *Elections and Conflict Management in Africa*, eds. Timothy D. Sisk and Andrew Reynolds (Washington: U.S. Institute of Peace, 1998): 71-80; Andrew Reynolds, *Electoral Systems and Democratization in Southern Africa* (Oxford: Oxford University Press, 1999).

⁴ Timothy D. Sisk, *Power Sharing and International Mediation in Ethnic Conflicts* (Washington: U.S. Institute of Peace Press, 1996); Bernard Grofman and Robert Stockwell, "Institutional Design in Plural Societies: Mitigating Ethnic Conflict and Fostering Stable Democracy," in *Economic Welfare, International Business and Global Institutional Change*, eds. Ram Mudambi, Pietro Navarra, and Guiseppe Sobbrino (New York: Edward Elgar Press, 2003); Milton Esman, "Ethnic Pluralism: Strategies for Conflict Management," in *Facing Ethnic Conflicts: Toward A New Realism*, eds. in Andreas Wimmer, et al. (Lanham: Rowman and Littlefield, 2004): 203-211; John McGarry, Brendan O'Leary, and Richard Simeon, "Integration or Accommodation? The Enduring Debate in Conflict Regulation," in *Constitutional Design for Divided Societies: Integration or Accommodation?* ed. Sujit Choudhry (Oxford: Oxford University Press, 2008): 41-88.

⁵ These definitions are not universal in the scholarly literature. In particular, there is debate about whether "centripetal" designs should be categorized under accommodation or integration. Centripetal designs typically employ some of the main political institutions of integration, including a presidential system and majoritarian elections. However, they also employ other political institutions – such as the alternative vote, federalism, or requiring widespread geographic support to get elected – to increase the chance that minority groups and their concerns will be represented in government, which is a goal of accommodation. Yet, centripetal systems in divided societies also often result in the exclusion of at least one substantial minority group from each government, an outcome that is antithetical to accommodation. Accordingly, it is appropriate to locate centripetalism in the middle of the spectrum, in between integration and accommodation.

⁶ Accordingly, the narrower metric of "centralization" would be a suboptimal proxy to test theories of integration and accommodation. This is demonstrated by comparing the coding of constitutional design, in Poupko's database of this project, to the coding of centralization by Stephen N. Ndegwa, *Decentralization in Africa: A Stocktaking Survey*, Africa Region Working Paper Series No. 40 (Washington: World Bank, 2002).

⁷ For further information on the methodology, see Kuperman, 2011.

⁸ Arend Lijphart, "The Wave of Power-Sharing Democracy," in *The Architecture of Democracy: Constitutional Design, Conflict Management, and Democracy*, ed. Andrew Reynolds (Oxford: Oxford University Press, 2002): 37-54. More specifically, he advocates a power-sharing executive, parliamentarianism, decentralization via grants of autonomy, proportional-representation elections, and proportionality in civil society. See also, Arend Lijphart, "Constitutional Design for Divided Societies," *Journal of Democracy* 15, 2 (2004): 96-109.

⁹ Donald Horowitz, "Constitutional Design: Proposals Versus Processes," in *The Architecture of Democracy: Constitutional Design, Conflict Management, and Democracy*, ed. Andrew Reynolds (Oxford: Oxford University Press, 2002): 15-36. Similar views are expressed by Benjamin Reilly, *Democracy in Divided Societies: Electoral Engineering for Conflict Management* (Cambridge: Cambridge University Press, 2001).

¹⁰ David A. Lake and Donald Rothchild, "Territorial Decentralization and Civil War Settlements," in *Sustainable Peace: Power and Democracy after Civil Wars*, eds. Philip G. Roeder & Donald Rothchild (Ithaca: Cornell University Press, 2005): 109-132. Similar conclusions are reached by Svante E. Cornell, "Autonomy as a Source of Conflict: Caucasian Conflicts in Theoretical Perspective," *World Politics* 54, 2 (2002): 245-276.

¹¹ Richard H. Pildes, "Ethnic Identity and Democratic Institutions: A Dynamic Perspective," in *Constitutional Design for Divided Societies: Integration or Accommodation?* ed. Sujit Choudhry (Oxford: Oxford University Press,

2008): 172-201; Stefan Wolff, "Building Democratic States after Conflict: Institutional Design Revisited," *International Studies Review* 12, 1 (2010): 128-141.

¹² See, for example, Daniel N. Posner, *Institutions and Ethnic Politics in Africa* (Cambridge: Cambridge University Press, 2005); Jessica Piombo, *Institutions, Ethnicity, and Political Mobilization in South Africa* (New York: Palgrave Macmillan, 2009).

¹³ A similar definition is used by Annegret Haase, Dieter Rink, Katrin Grossmann, "Urban Shrinkage as a Shock? Challenges for Modelling Human-Environmental Interaction," 2012 International Congress on Environmental Modelling and Software, Managing Resources of a Limited Planet, Sixth Biennial Meeting, Leipzig, Germany, http://www.iemss.org/sites/iemss2012/proceedings/H3_0386_Haase_et_al.pdf, 3, which reviews the literature on shocks related to demographics, economics, and climate. It summarizes as follows: "The use of the term shock in all these debates relates to the following type of events or developments: drastic changes of partly unexpected nature that represent challenges for existing natural and societal regulation systems and mechanisms destabilizing current societal organization principles (e.g. market principles, pension systems, welfare system). Temporally seen, shocks may relate to sudden events but also to longer-term developments when it comes e.g. to ageing or climate change."

¹⁴ Lars-Erik Cederman, Andreas Wimmer and Brian Min, "Why Do Ethnic Groups Rebel? New Data and Analysis," *World Politics* 62 (2010): 87-119.

¹⁵ Paul Collier, Anke Hoeffler, and Dominic Rohner, "Beyond Greed and Grievance: Feasibility and Civil War," *Oxford Economic Papers* 61, 1 (2009): 1-27.

¹⁶ James D. Fearon and David D. Laitin, "Ethnicity, Insurgency, and Civil War," *American Political Science Review* 97, 1 (February 2003): 75-90.

¹⁷ Barbara F. Walter, "Designing Transitions from Civil War," in *Civil Wars, Insecurity, and Intervention*, eds. Barbara F. Walter and Jack Snyder (New York: Columbia University Press, 1999): 38-69.

¹⁸ Because shocks do have such causes, they are not strictly an "independent variable," but this term is commonly used by social scientists to denote a causal variable that is under examination, even if it may be caused by other variables.

¹⁹ Examples are found in the following: Sammy Smooha, "Types of Democracy and Modes of Conflict Management in Ethnically Divided Societies," *Nations and Nationalism* 8, 4 (2002): 423-431; Ulrich Schneckener, "Making Power-sharing Work: Lessons from Successes and Failures in Ethnic Conflict Regulation," *Journal of Peace Research* 39, 2 (March 2002): 205; Reynolds, *Electoral Systems and Democratization in Southern Africa*, 106.

²⁰ Robert H. Jackson and Carl Gustav Rosberg, *Personal Rule in Black Africa: Prince, Autocrat, Prophet, Tyrant* (Berkeley: University of California Press, 1982).

²¹ See, for example, <http://www.systemicpeace.org/polity/polity4.htm>.

²² Cederman, Wimmer, and Min, "Why Do Ethnic Groups Rebel?"

²³ Thanks to Terrence Lyons for this insight.

²⁴ See Shaheen Mozaffar, "Electoral Rules and Post-Civil War Conflict Management: The Limitations of Institutional Design," *Strengthening Peace in Post-Civil War States: Transforming Spoilers Into Stakeholders* (Chicago: University of Chicago Press, 2010): 79-104.

²⁵ See Michaela Mattes and Burcu Savun, "Fostering Peace After Civil War: Commitment Problems and Agreement Design," *International Studies Quarterly* 53, 3 (2009): 737-759.

²⁶ For general principles of case selection, see Stephen Van Evera, *Guide to Methods for Students of Political Science* (Ithaca: Cornell University Press, 1997).

²⁷ The cases were selected by consensus at an organizational meeting, where the international participants included the prospective authors and expert commentators.

²⁸ Cases were selected prior to the development of this project's database, which rigorously codes the constitutional design of all 53 African countries at the start of 2011. The *de facto* coding in the database subsequently categorized this project's seven cases as follows: two Hyper-integrative (Senegal and Zimbabwe); two Integrative (Ghana and Sudan); two Balanced (Kenya and Nigeria); and one Accommodative (Burundi). None of the project's seven cases is coded as having a Hyper-accommodative constitutional design in early 2011, but there were only two countries in Africa that were coded as having such a design functioning at the time: Mauritius and South Africa.

²⁹ The exact figure is 79.2 percent, representing 42 out of 53 countries.

³⁰ The liberal institutions that appear most important in this case study are those pertaining to the separation of powers and the integrity of elections. Logically, the liberal guarantee of individual rights – such as property, due process, speech, assembly, religion, and a free press – may also be quite important, because these rights undergird the proper functioning of liberal institutions.

³¹ Horowitz, “Constitutional Design: Proposals Versus Processes.”

Chapter 6. Assessing Effectiveness of Governance Aid in Africa

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Alongside the Third Wave of democratization in the latter half of the Twentieth Century, significant scholarly attention has been devoted to understanding the contexts within which democracy may grow or atrophy. This research has reached a degree of consensus about a range of factors that impact democratic consolidation, agreeing that *on average* democracy grows in countries experiencing economic growthⁱ and in those buttressed by democratic neighbors,ⁱⁱ while democracy is slower to take root in environments with conflictⁱⁱⁱ or social cleavages.^{iv}

An additional line of inquiry began in recent years to assess whether international aid to promote these democratic changes is indeed effective in doing so. Landmark recent studies on U.S. democracy assistance worldwide found that democracy aid overall *does* have a positive impact on democratic development—and it has the most impact in Africa.^v

Yet while research to date has made strides in identifying the contextual factors that impact democratic development, and in affirming that democracy aid contributes to that development, it has not identified empirically *how* democracy aid has brought about this success. The questions remain: what are the crucial defining features of a successful democracy promotion effort? Why does the same level of investment in similarly situated countries not produce comparable democratic gains? This CCAPS study thus seeks to identify the causal mechanisms through which democracy aid positively impacts democratic development in a set of African countries.

Introduction

Understanding what drives the success of democracy promotion programs has significant potential implications for U.S. and international investments in promoting good governance in Africa. The U.S. administration's FY 2017 budget request for governance assistance in Africa is \$343 million—a 96 percent increase from FY 2015 actual figures.^{vi} And the rising level of U.S. governance assistance seen in Africa is seen globally as well, with the administration requesting \$2.7 billion globally for governance assistance in FY 2017, compared to \$1.9 billion spent in FY 2015.^{vii} Having empirical evidence on the causal mechanism through which democracy aid most directly impacts governance quality could help policy planners allocate democracy aid funds for maximum impact.

Moreover, effective governance reform in Africa could reduce the need for external military or humanitarian interventions in fragile African states. The international community often provides humanitarian relief or conflict response in states that lack the capacity to execute these efforts on their own. Nascent democratic governments in Africa face considerable—and growing—challenges from climate change, violent non-state actors, demographic shifts, and other global trends that stress state capacity and resources. Already 19 African countries are labeled as “extreme” or “high” fragility states, with an additional 18 earning a lower but still unstable warning of “moderate” fragility.^{viii} Democracy aid could provide critical support to build the capacity of these states to handle the diverse challenges they face, bolstering institutional and

societal resilience, while reducing the need for U.S. military or humanitarian intervention in the future.

At its core, this study investigates the origin of change in a political system. There is a vigorous academic debate over whether political change is shaped and determined by the formal institutions or the informal norms and practices at work in a political system. This study seeks to inform this debate by assembling empirical evidence on democracy aid programs over time in a range of contexts to examine the causal mechanisms through which democracy aid impacts the political system.

Study Context

Prior studies and theories on democratic development put forward two competing arguments regarding what shapes change in a political system. These theories, broadly defined, differ in whether they see democratic development as being driven by changes to *formal government institutions* or by changes to *informal practices and norms* in the broader political context. The logic behind these theories reflects two distinct assumptions about the causal mechanism through which change occurs in a political system and thus through which democracy aid could potentially impact democratic development.

The first set of theories on democratic development highlights the role of formal institutions in democratic transformation. This literature argues that institutions provide the decisive parameters for guiding political change and overcoming challenges to democratic transition and consolidation. Advocates for this line of reasoning famously advance institutional solutions to alleviate societal conflict,^{ix} manage ethnic divisions,^x construct political identities and promote social cohesion,^{xi} and generally guide society toward a stable democracy.^{xii} In this thinking, institutions fill an irreplaceable role in structuring relations in society and offering a credible way to engage the diverse actors that must be involved if the democratic project is to succeed^{xiii}; formal institutions are thus the central mechanism by which democratic change takes root.^{xiv}

This line of reasoning about the cause of *political change* could likewise inform assessments of the mechanisms by which democracy *aid* contributes to this change. In prioritizing the role of institutions, this literature implies that the crucial factor in the success of democracy promotion efforts would be the legal and policy changes promoted in formal institutions, which in turn structure the choices and relations of societal actors, thereby moving them toward democracy. Thus, if this approach is correct, similar countries experiencing successful versus unsuccessful democratic progress should show a divergence in the type of institutional reforms promoted in those countries.

The second set of theories on democratic development has a wider lens, underscoring the influential role played by the broader context within which institutions operate in a political system. This literature moves beyond assessing formal structural and legal changes in institutions to consider how *informal practices and norms* impact the behavior of institutions and actors in that society. This literature asserts that formal institutions are not as independent as they may appear, with their actions and impact instead being shaped by the broader context within which they are organized in relation to each other. Hall and Taylor, for example, note that the political

system, and thus political change, involves both formal and informal processes that link diverse sectors of government and society within a unified structure; this complex combination of factors thus generates ‘distinctive’ outcomes in each location.^{xv}

A central facet of this second set of literature, then, is its assertion that the same institutional reforms will have different outcomes in different contexts. This underscores the unique context and trajectory of each country—a uniqueness determined by the particular series of historical events and current conditions in that country.^{xvi} Lipset and Rokkan go so far as to argue that formal institutions are inconsequential and that it is instead these key moments in history that set the course and determine future outcomes for each country.^{xvii}

This second line of reasoning about the cause of political change would also frame our understanding of how democracy aid may contribute to such change. In asserting that change arises through the complex set of formal and informal processes that make up a state’s institutional landscape, this literature implies that democratization efforts cannot focus on reforming formal institutions alone, but must also change the informal patterns of behavior that could impact democratic consolidation. If this literature is correct, similar countries experiencing successful versus unsuccessful democratic progress should likewise diverge in how democracy aid in each country sought to develop those informal democratic norms and domestic support for democratic change.

So which is it: Are formal institutions the lynchpin to democratic development? Or are informal practices and norms equally if not more important? In terms of how democracy *aid* may influence the process of democratic development, the answer may lie somewhere in between. Yet to understand when and how democracy aid successfully impacts democratic progress—through formal institutions, informal norms, or both—requires an analysis of the strategies that democracy aid programs have employed to advance change in these systems through various formal and informal channels.

Importantly, prior studies on democracy aid have found that the environment in which *democratic development* advances most consistently is not always the environment in which *democracy aid* has the most impact. Initial studies found, for example, that democracy *aid* has a positive impact in countries with high levels of ethnic fragmentation and in countries with low levels of human development^{xviii}—both of which are contexts known to challenge democratic *development* more generally. This underscores the need to better understand not only what contexts are ripe for democratic development generally, but what contributes to that development at different points in democratic consolidation. The factors that spur democratic advancements in the early days of a democracy—after conflict or under new political and economic institutions—may not be the same dynamics that drive democratic development in the later stages of a democracy. Specific democracy *aid* interventions, then, may also have greater or lesser effect at these different stages of a democracy.

This research project considers two broad mechanisms theorized to impact democratic development—formal institutions and informal norms—and within this framework examines how democracy aid leverages these mechanisms in varied contexts of democratic development.

Methodology

Parsing out which of these theorized causal mechanisms is at work in successful democracy promotion requires an examination of empirical evidence from democracy promotion efforts in varied contexts and at varied stages of democratic development. This project thus examines the impact of democracy aid in paired countries with similar socioeconomic and political conditions and dissimilar democratic outcomes. The case studies seek to identify which democracy and governance programs—under what conditions—had the most impact in selected African countries and to examine the causal mechanisms at work.

The case studies examine democracy aid programs and strategies implemented for two decades after 1990 by four major donors working in all case study countries—the United States, the African Development Bank, the United Nations Development Programme, and the World Bank—as well as other major donors of democracy aid in each country. This aims to capture the majority of democracy aid in each country while also allowing comparisons of several donors across all countries under study. Most prior studies assessing democracy promotion have considered only a single donor. This study’s consideration of democracy aid from multiple donors aims to provide a more complete picture of democracy aid in each country and thus better prospects at capturing the potential causal mechanism linking democracy aid to changes in a country’s level of democratic development.

Data on democracy aid programs and impacts has been collected through donor program planning and evaluation documents; indicators of democracy aid and democratic development; and indicators of socioeconomic conditions that could impact democratic development.

Research Questions

The research questions aim to assess whether approaches to democracy promotion varied between similar countries that have experienced successful and unsuccessful democratic change. Any variations are then assessed as to whether they provide evidence for different theoretical explanations of what causes political change. In doing so, the study examines the causal mechanisms argued by theories on *formal institutions* (i.e. whether promoting particular types of institutional changes proved critical) and theories on *informal norms* (i.e. whether accounting for informal patterns of behavior and interacting contextual factors proved critical).

To achieve this, the study considers three related but distinct arguments found in democracy literature on the role of democratic institutions and norms.^{xix} This study explores whether there is empirical evidence for any or all of the following arguments:

1. Democracy aid programs that *increase the representativeness* of formal government institutions will lead to improvements in a country’s democratic development.
2. Democracy aid programs that *increase checks and balances* across formal government institutions will lead to improvements in a country’s democratic development.
3. Democracy aid programs that foster *democratic norms and democratic mobilization* will lead to improvements in a country’s democratic development.

The case study design allows comparative analysis of these questions in several ways. It assesses differences in each donor's approach over time in each country, differences in the donor's approach across countries sharing similar contexts but different democratic outcomes, and differences in the donor's approach across country pairs in different contexts. The study also allows comparison of democracy aid strategies across the four donors under study in all case countries.

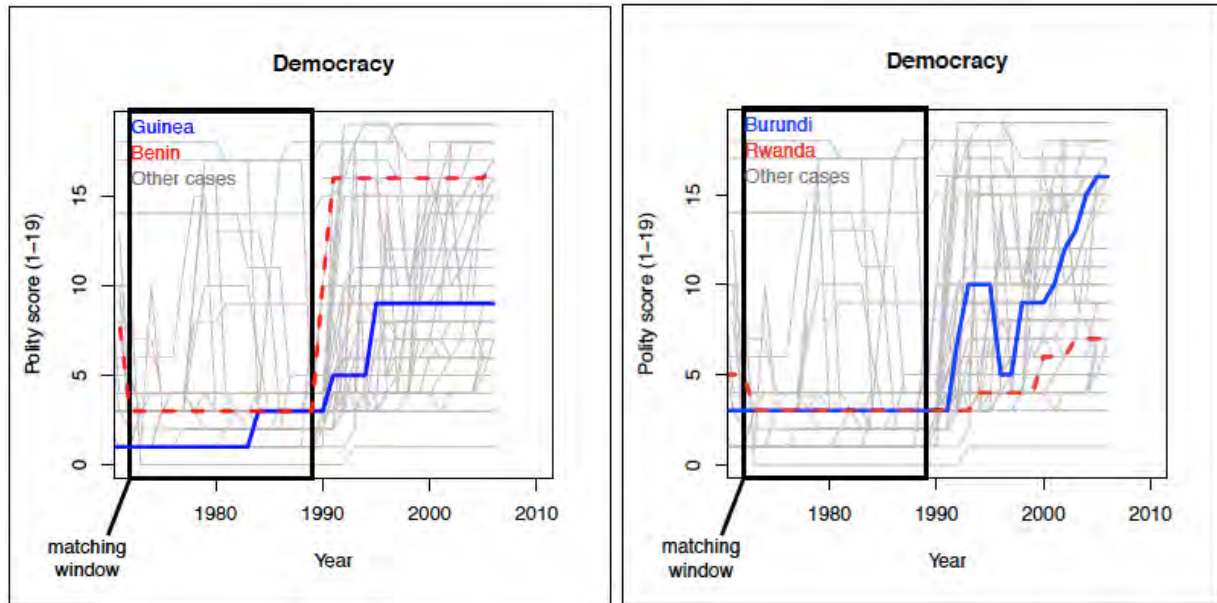
Case Matching

Because the case studies explore how the design of democracy aid impacts its effectiveness in contributing to the overall level of democracy in a country, it is critical that other factors that could potentially explain variations in democracy levels across countries are as equal as possible between paired cases.

The case matching process thus identified pairs of countries in Africa with similar socioeconomic and political conditions and dissimilar democratic outcomes. Countries were paired using a three-stage statistical matching process.^{xx} Figures 1 through 3 show a comparison of countries on the variables used to match countries for this study, and Appendix 1 describes the indicators and data used for each variable.

In the first stage, all countries receiving democracy aid in Africa were matched on the similarity of their democracy trends prior to the start of the study in 1990. This includes measures of short- and long-term democratic trends. Figure 1 shows the results for the Guinea-Benin and Rwanda-Burundi case pairings. In all figures, the selected cases are shown in their respective colors, and the cases that were not chosen are shown in gray to convey the range of possible country values for each indicator in each year. The time window used for matching is shown in the black box, and cases were selected to be similar in these time periods only. The closer the country lines are to each other, the better the match.

Figure 1. First stage of matching process for case selection. All countries receiving democracy aid in Africa were matched on the similarity of their short- and long-term democracy trends prior to the start of the study in 1990. Below are results for the Guinea-Benin and Burundi-Rwanda case pairings.

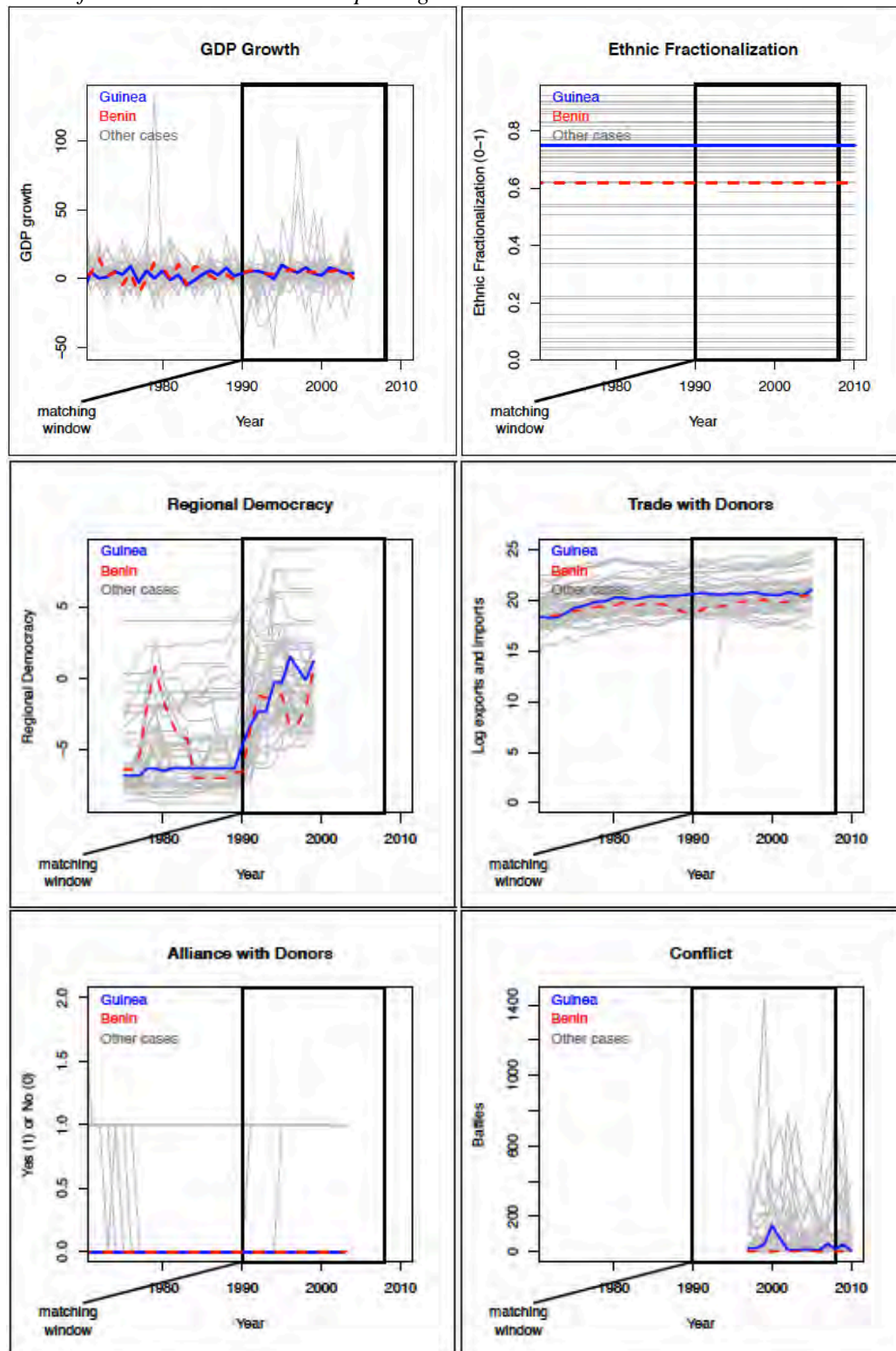


Source: All graphs included here were produced by Rich Nielsen based on indicators selected by the author.^{xxi}

In the second stage, countries with the most similar democratic starting points in 1990 were then paired according to their similarity on socioeconomic and political dynamics *during* the study period. This sought to account for alternative explanations for democratic development and key predictors of democracy aid allocation and effectiveness, including regional democratic diffusion,^{xxii} economic growth,^{xxiii} ethnic fractionalization,^{xxiv} conflict,^{xxv} trade, and military alliances.^{xxvi} This statistical matching process produced a list of prospective case study pairs that were most similar on the matching criteria from these first two stages. Figures 2 and 3 show the results for the Guinea-Benin and Rwanda-Burundi case pairings.

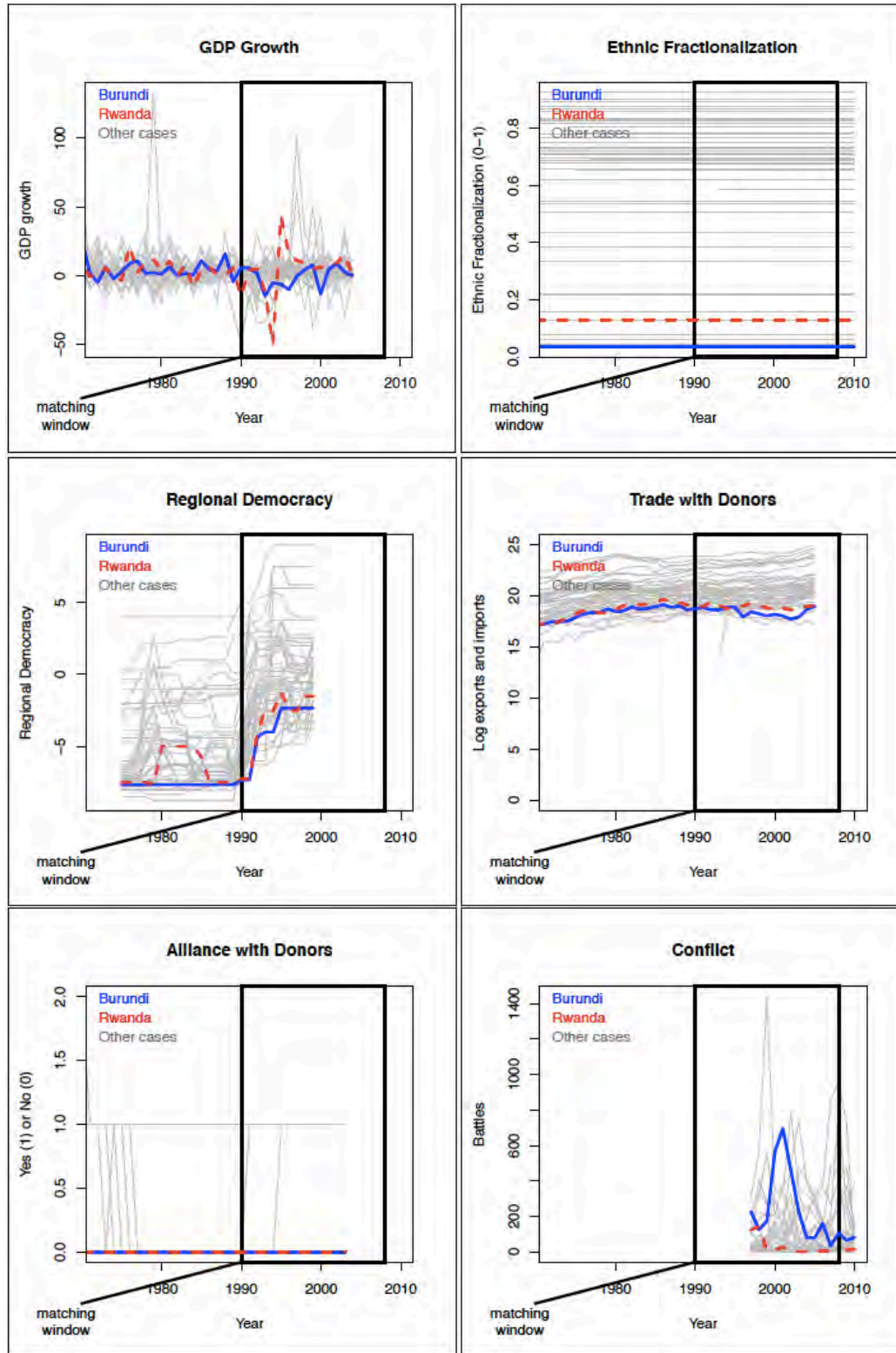
In the third stage, the author selected final pairs that also had similar levels of total democracy aid during the two-decade study period (1990-2010) and dissimilar levels of democratic development by 2012.^{xxvii} To the extent possible, final pairs were selected such that they also had similar colonial history, Cold War alliances, natural resource wealth, population density, and land size.

Figure 2. Second stage of matching process for case selection (Guinea-Benin results). Countries with the most similar democratic starting points in 1990 were then paired based on their similarity on six, equally weighted indicators of socioeconomic and political dynamics during the study period. Below are the results for the Guinea-Benin case pairing.



Source: All graphs included here were produced by Rich Nielsen based on indicators selected by the author.

Figure 3. Second stage of matching process for case selection (Burundi-Rwanda results).



Source: All graphs included here were produced by Rich Nielsen based on indicators selected by the author.

The country pairs selected for study represent two different contextual settings shown in scholarly literature to have important influences on democratic development: first, countries recovering from conflict (Burundi and Rwanda) and, second, countries with low levels of human development (Benin and Guinea). The study is thus able to explore how democracy promotion efforts have responded to varying degrees of conflict and socioeconomic constraints.

The results of these case studies are discussed in full report available on the CCAPS website.

Prospective Impact

The human and financial stakes are high in democracy promotion. It is not enough to know which contexts are most ripe or hostile for democratic development. Effective democracy promotion also requires knowing how to best design democracy aid programs to work within these external constraints.

Donors must know not only *that* democracy aid and democratic progress are related in a particular context but also *how* democracy aid is most effectively designed to meet the particular needs of that context. The hope here is that an empirical analysis of the factors driving political change in diverse contexts can inform the design of democracy aid programs and in turn potentially help maximize their effectiveness in building governance capacity and societal resilience.

ⁱ Studies using a range of methods have produced general agreement that economic development strengthens democracy. Przeworski and Limongi find that, while economic growth is not related to *transitions* to democracy, it does strengthen *existing* democracies; see Adam Przeworski and Fernando Limongi, “Modernization: Theories and Facts,” *World Politics*, 49 (January 1997): 155-183. These results have been reinforced by subsequent studies, for example by Adam Przeworski et al., *Democracy and Development: Political Institutions and Well-Being in the World, 1950-1990* (New York: Cambridge University Press, 2000); and Kristian Skrede Gleditsch and Michael D. Ward, “Diffusion and the International Context of Democratization,” *International Organization* 60, 4 (2006): 911-933.

ⁱⁱ Prior studies using a variety of methods and datasets have provided consistent findings that democratic diffusion from neighboring countries has a positive impact on a country’s democratic development. For example, Gleditsch and Ward, 917-921, 924-925; and Daniel Brinks and Michael Coppedge, “Diffusion Is No Illusion: Neighbor Emulation in the Third Wave of Democracy,” *Comparative Political Studies* 39, 4 (2006): 463-489.

ⁱⁱⁱ Gleditsch and Ward find that democracies are more likely to survive in contexts with lower conflict, 924, 926.

^{iv} Varied studies assert that a high level of ethnic division in a country can present challenges for democratic consolidation. For an overview of the areas of agreement on this relationship, see Arend Lijphart, “The Wave of Power-Sharing Democracy,” in *The Architecture of Democracy: Constitutional Design, Conflict Management and Democracy*, ed. Andrew Reynolds (Oxford: Oxford University Press, 2002), 38-9. For a challenge to studies asserting a relationship between democratic consolidation and ethnic fragmentation, see Steven M. Fish and Robin S. Brooks, “Does Diversity Hurt Democracy?” *Journal of Democracy* 15, 1 (2004): 154-166.

^v Two quantitative studies analyzed democracy assistance from the U.S. Agency for International Development from 1990 through 2003 and 2004, respectively. See Steven E. Finkel, Aníbal Pérez Liñán, and Mitchell A. Seligson, “The Effects of U.S. Foreign Assistance on Democracy Building, 1990-2003,” *World Politics* 59, 3 (2007): 404-440; and Steven E. Finkel et al., *Deepening Our Understanding of the Effects of U.S. Foreign Assistance on Democracy Building, Final Report* (Washington: U.S. Agency for International Development, 2008).

^{vi} *FY 2017 Congressional Budget Justification, Foreign Operations Appendix 3* (Washington: U.S. Department of State, 2016), 541-558.

^{vii} *Ibid.*, 518.

^{viii} Monty G. Marshall and Benjamin R. Cole, *Table 1: State Fragility Index and Matrix 2014* (Vienna: Center for Systemic Peace, 2014).

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- ^{ix} Torben Iversen and David Soskice, "Distribution and Redistribution: The Shadow of the Nineteenth Century," *World Politics* 61, 3 (2009): 438-86.
- ^x Donald L. Horowitz, "Democracy in Divided Societies," *Journal of Democracy* 4, 4 (1993): 18-38; Lijphart 2002; and Arend Lijphart, "Constitutional Design for Divided Societies," *Journal of Democracy* 15, 2 (2004): 96-109.
- ^{xi} Robert Bates, Rui de Figueiredo, and Barry Weingast, "The Politics of Interpretation: Rationality, Culture, and Transition," *Politics and Society* 26, 4 (1998): 603-642.
- ^{xii} Kenneth Shepsle, "Studying Institutions: Some Lessons from the Rational Choice Approach," *Journal of Theoretical Politics* 1, 2 (1989): 131-47.
- ^{xiii} Daron Acemoglu and James Robinson, *Economic Origins of Dictatorship and Democracy* (Cambridge: Cambridge University Press, 2005); and Adam Przeworski, "Democracy as a Contingent Outcome of Conflicts," in *Constitutionalism and Democracy*, ed. Jon Elster and Rune Slagstad (Cambridge: Cambridge University Press, 1988), 59-80.
- ^{xiv} Gary Cox, "Electoral Rules and Electoral Coordination," *Annual Review of Political Science* 2 (1999): 145-161.
- ^{xv} Peter Hall and Rosemary Taylor, "Political Science and the Three New Institutionalisms," *Political Studies* 44, 4 (1996), 937. Hall and Taylor describe the institutional organization of a state as the "formal or informal procedures, routines, norms and conventions embedded in the organizational structure of the polity" that structure "relations among legislators, organized interests, the electorate and the judiciary," 938.
- ^{xvi} Hall and Taylor; and Paul Pierson, "Increasing Returns, Path Dependence, and the Study of Politics," *American Political Science Review* 94, 2 (2000): 251-267.
- ^{xvii} Seymour Martin Lipset and Stein Rokkan, "Cleavage Structures, Party Systems, and Voter Alignments," in *Party Systems and Voter Alignments*, ed. Seymour Martin Lipset and Stein Rokkan (New York: Free Press, 1967).
- ^{xviii} Finkel, Liñan, and Seligson; and Finkel et al.
- ^{xix} These hypotheses were developed by the full research team comprised of Ashley Moran, Brooke Russell, Dan Robles-Olsen, Matt Deal, and Rob Wiczorek.
- ^{xx} Case matching was implemented in collaboration with Rich Nielsen, based on a computer-assisted case matching methodology he developed to leverage large amounts of data in identifying the best statistical matches for paired comparisons. For the methodology underlying his computer-assisted matching, see Rich Nielsen, "Case Selection via Matching," *Sociological Methods & Research*, online release (October 27, 2014): 1-29. For the present study, the author selected indicators for use in case matching based on a review of relevant literature, then Nielsen applied his model in the first two stages of case matching described in this brief.
- ^{xxi} For the methodology underlying his computer-assisted matching, see Nielsen 2014.
- ^{xxii} Prior studies have shown that democratic diffusion is associated with democratic development. See Gleditsch and Ward; and Brinks and Coppedge.
- ^{xxiii} Prior studies have found consistent links between economic growth and democratic development; see Przeworski and Limongi, Przeworski et al., and Gleditsch and Ward. Further, studies have found that democracy aid is more effective in countries with low GDP (see Finkel et al.) and that low GDP is a predictor of democracy aid allocation; for the latter, see Richard Nielsen and Daniel Nielson, "Triage for Democracy: Selection Effects in Governance Aid," unpublished manuscript, August 2010; and Mike Findley et al., "Preliminary Results: Finding the Bright Spots in USAID Democracy and Governance Assistance to Africa," unpublished manuscript developed for the Robert Strauss Center, April 2011.
- ^{xxiv} A prior study found that democracy aid is more effective in countries with high ethnic fractionalization; see Finkel et al.
- ^{xxv} A prior study found that democracy aid is less effective in conditions of political conflict; see Finkel et al.
- ^{xxvi} Prior studies found that trade and military alliances are predictors of democracy aid allocation (Nielsen and Nielson) across many types of democracy aid (Findley et al.), with trade partners receiving more democracy aid and military alliance partners receiving less democracy aid.
- ^{xxvii} "Total democracy aid" was based on the amount of democracy and good governance aid committed from 1990 to 2010, as reported by AidData, *AidData 2.2 Provisional Dataset*, accessed September 12, 2013. The "level of democratic development" was assessed using Polity IV and Freedom House scores.

Chapter 7. Institutional Capacity for Natural Disasters: Case Studies in Africa

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Executive Summary

Natural hazards, such as floods, drought, earthquakes, and tropical cyclones, do not necessarily result in disasters, but they present a clear policy challenge for national governments: how does a country prepare for the often unexpected? This challenge is exacerbated by the fact that natural shocks have the potential to impose significant economic costs and loss of life. These dynamics have resulted in national governments often adopting diverse natural disaster management strategies. This chapter details the findings of a research initiative under the CCAPS program to explore the causes of variation in government policies to reduce the risk of, prepare for, and respond to natural disasters. The discussion focuses on the African continent and ten case studies within Africa, but the findings of the analysis should be relevant to a broader set of cases, particularly developing countries.

Introduction

While natural disasters are a frequent risk around the world, and national governments play a key role in disaster management, often intermediating between local and international actors, analysts have little leverage for understanding why national governments take, or fail to take, a particular stance toward investment in activities that should reduce the overall vulnerability of their countries to natural hazards. This lack of knowledge regarding the drivers of government behavior is not due to a dearth of theoretical insights into the potential causes of variation in natural disaster policies. Indeed, recent academic literature has developed a range of potential explanations for observed variation in the ways in which governments do, and do not, prepare for and respond to natural disasters. But a key current limitation is the lack of empirical testing to evaluate which of these individual hypothetical explanations, or which combination of hypotheses, provides the greatest leverage for explaining particular policy outcomes. Without evaluating the relationship between theory and reality on the ground, there is little basis for making practical recommendations for strategies to improve disaster management policies in general.

Project Purpose

The goals of the project presented here are two-fold. The first goal is to provide a current assessment of natural disaster management capacities in a set of African states. This effort emphasizes the role of national policies in providing a framework for all actors engaging in natural disaster-related programs and shaping the environment in which these activities occur. The second is to offer the first comprehensive empirical test of arguments regarding the incentives of states to invest in disaster management activities. Based on an extensive literature review, the research documents the range of hypotheses in the social science literature on the potential factors influencing government policies regarding natural disaster management. These hypotheses are then tested, using case-based evidence from ten African states.

In order to achieve these goals, this project takes a wide-ranging perspective and uses a qualitative paired-case study design. In doing so, the analysis provides evidence both for and against a number of theoretical hypotheses while also offering a more nuanced perspective on the ways in which the hypothetically important characteristics of states interact to affect policy choices and institutional robustness. This has important implications for understanding the relationship between national governments and both bilateral and multilateral aid agencies in the face of natural shocks. Both domestic and international actors need to know which kinds of precursor conditions must be supported in order for risk-reducing institutions to be able to thrive in a challenging new century. Are resources and attention best spent: building up the institutional bureaucracy in disaster management directly, supporting the personal and financial commitments of political leaders to facing natural hazards in a structured way, or contributing to the improvement of underlying economic and political realities that can be assumed to generate good disaster institutions spontaneously? This research attempts to shed new light on these questions and to inform debates over the most appropriate and efficient uses of aid and national resources for dealing with natural shocks.

This project approaches the question of natural disaster preparedness and response primarily from the perspective of national governments and attempts to address the potential causes of government decisions regarding investment, broadly understood, in countries' abilities to reduce the risk of, prepare for, and respond to disasters. While quite broad in its aims, the goals set aside more than they attempt to achieve, including, for example, the decision making of international aid agencies, local NGOs, and more generally the dynamics of post-disaster recovery. Instead, the objectives are, first, to gain some traction in understanding the policies, or lack thereof, themselves and second, the effects of these policies on the actual capacity of the state to deal with the threat of natural hazards.

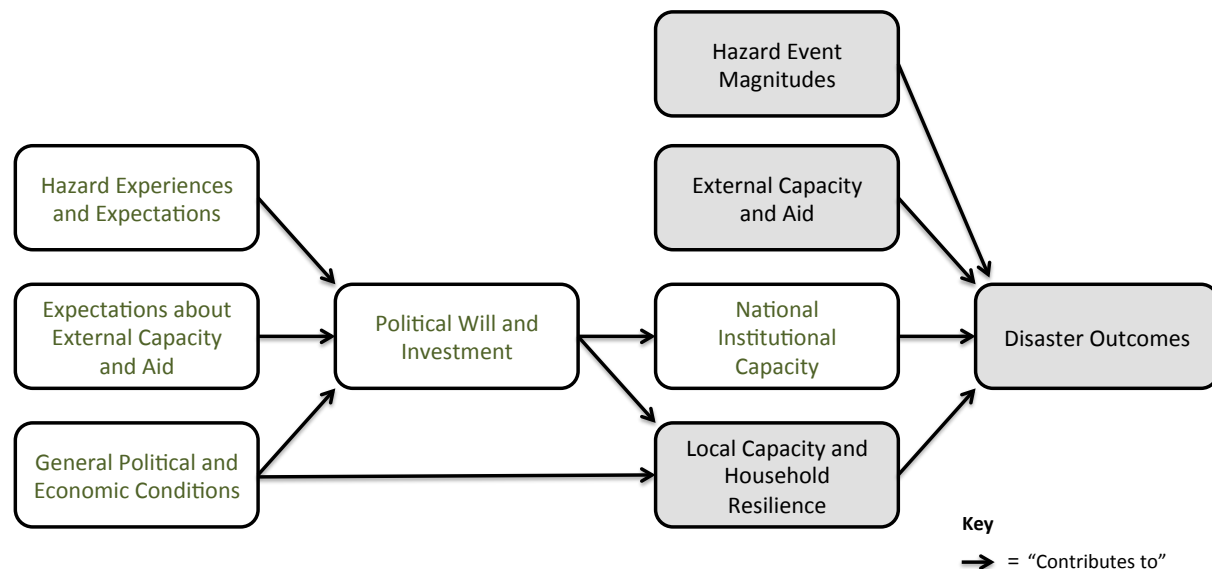
This perspective, while reasonably narrow, still runs up against the constraints of a highly complex area of analysis. In order to gauge the quality of government capacities to prepare for and respond to natural shocks, it is necessary to at least attempt to have some sense of both the outcomes of natural shocks and hypotheses on the causal chain leading to those outcomes. The analysis is framed such that national policies, and the implementation of those policies, are the primary dependent variables of the study, but this comes with the assumption that these variables have some independent effect on the outcomes of natural shocks. This is a complex and often problematic assumption for two main reasons. First, explanatory models of disaster outcomes often rely on a long causal network of lower-order factors, many of which—such as electoral conflict, population dispersion, and climactic patterns—are themselves very complex, poorly understood empirically, and often subject to stochastic shocks in any given real-world situation. Second, researchers can all too easily conflate one kind of concept (such as “outcome” in terms of disaster deaths) with a logically related one (such as “outcome” in terms of how much money was invested in preparedness and response), making comparisons within and across seemingly similar research initiatives quite difficult.

Figure 1 illustrates the main factors considered in this study within a local “neighborhood” of relationships that are relevant to disaster risk. The boxes in white are the main topics of study, while those in gray are closely related areas outside the focus of the research. The project

reviews and pursues some of the most prominent hypotheses concerning how diverse factors affect a government’s political will to invest in disaster outcome mitigation, as manifest in the commitment of money, skilled personnel, and political capital to dealing with the problem. It also examines how selected bureaucratic and institutional factors mediate between that investment input and the subsequent perceived capacity of national institutions to carry out those functions they are funded to perform.

In this project, the term “national institutional capacity” is used to encapsulate both the effectiveness of pre-hazard risk reduction programs and post-hazard response and recovery programs. Logically, these efforts can flow into each other and make distinguishing between the two difficult: investing in a levee to hold back flood waters, investing in boats to be ready to ferry stranded victims, or investing in employees who are trained to disburse ad-hoc recovery aid funds are economic investments representing both preparedness and response. In addition, the research tends to find that the pre-event preparedness and risk reduction institution is also the body that is charged with disaster response. However, from the standpoint of international, and some domestic, actors, these activities are differentiated, with greater attention at the international level in recent years placed on risk reduction, rather than preparedness or response. Domestic actors, in contrast, are still more likely to focus on response and, to a lesser degree, preparedness. There can be a very wide gap in both public and government views on preparation and response, as discussed below.

Figure 1. Research Focus on Factors Influencing Disaster Outcomes



Existing Hypotheses

The current literature highlights a large number of hypotheses to explain variation in the degree to which national governments prepare for and respond to natural shocks. In particular, an important focus of this work is the political and economic factors influencing policy-making, recognizing that “the incentives faced by human actors can affect the prevention, mitigation, and damage of natural disasters.”¹ These efforts have helped to increase attention to the behavior of political actors in shaping the outcome of otherwise “natural” events.

Perceived Risk

A key factor for states' disaster policies is likely to be the overall perceived risk of future hazards. In countries hard hit by disasters in the past, previous experience with international aid and the difficulty of dealing with diverse sources of assistance may help incubate policies to improve local disaster preparedness activities (instead of increasing the likelihood of reliance on external support).² The literature on this topic tends to emphasize the *formalization* of national knowledge about expected future hazards as the key parameter in that knowledge having an impact on investment decisions.

Economic Conditions

Economic arguments also predominate in much of the literature, with the typical expectation that wealthier governments will spend more on prevention.³ However, authors differ on the logic underlying this argument, with some emphasizing economies of scale while, with regard to earthquakes, Keefer et al. posit that "the opportunity costs of expenditures to limit earthquake mortality are higher in poor countries, so that rich countries should respond more strongly than poor countries to higher earthquake propensity."⁴ Other literature highlights the potential negative feedback effects from increasingly devastating disasters, which can threaten the productivity of wealthy countries or regions within countries while weighing down on poor economies and further dampening their ability to invest.⁵

Electoral Incentives and Democracy

The nature of the political system is also expected to play a role, and analysts have become increasingly cognizant that disaster and disaster-related policies are directly linked to political incentives, which can differ dramatically across countries. As Keefer notes, "government incentives to provide the public policies needed to mitigate disaster risk and damage vary across countries; institutions and politics are the sources of those incentives."⁶ A range of factors, however, can affect the nature of political incentives. While authors such as Kahn posit that democracy, in general, is associated with fewer deaths from natural disasters,⁷ Keefer argues that democracy, or electoral competition, alone is insufficient for explaining variation in disaster outcomes.⁸ Instead, Keefer, Neumayer, and Plumper suggest that institutionalization of the party system can boost the propensity of governments to prepare for natural shocks, in particular earthquakes, by increasing the demand for public goods provision. Specifically, "in countries where citizens or members of the ruling party can more easily sanction leaders for poor performance, leaders should respond more quickly to higher earthquake propensity."⁹ This characteristic, which can arise in both democratic and nondemocratic regimes, is argued to be even more relevant for policy outcomes than electoral competition on its own.

Electoral conditions may also shape the distribution of spending, both in terms of preparedness and response. Cohen and Werker argue that governments may target spending to favor "regions that are politically aligned with the party in power."¹⁰ Here, politicians in democratic environments may be more affected by "electoral myopia," in that they invest only in expectation of the next election, rather than for long-term preparedness. Authoritarian regimes may thus be more likely to invest in overall, rather than targeted, preparedness.

The expectation of future natural shocks may also interact with electoral conditions to affect policy. Spending on disaster preparedness is often difficult to translate into electoral benefits: “Building codes, early warning systems, disaster relief planning and floodplain management are all difficult for citizens to observe. Even if individuals can observe them, they cannot easily assess the contribution they make until a disaster occurs.”¹¹ The same opacity is a problem for both researchers and citizens: even where prevention spending can be identified in a budget, project quality and effectiveness can remain very difficult to assess after a hazard event has taken place. As a result, and because it is easier to evaluate the quality of spending on response, multiple authors highlight that voters are more likely to reward response spending than spending on preparedness and mitigation.¹² However, as natural shocks become more frequent, citizens may become less likely to punish politicians for the preparedness activities that then reduce the chances of a negative electoral response when a shock does occur.¹³

Political Development

Another political factor may be the overall character of government institutions. In particular, characteristics such as the degree of development in the bureaucracy and the presence of corruption in government operations may shape the quality of programs put into place to prepare for or mitigate the effects of natural shocks. With regard to corruption, the willingness of bureaucrats and politicians to skim funds from programs intended to support preparedness and response as well as to accept bribes from individuals and companies attempting to affect regulations or avoid their enforcement can limit the quality of policies put into place.

Political development more generally concerns the degree to which the bureaucracy is meritocratic and insulated from political whims in the implementation of policy. As Evans and Rauch¹⁴ have shown, the “Weberianness” of a bureaucracy, or the extent to which government agencies use meritocratic recruitment and offer predictable career paths, can be linked to policy outcomes such as economic growth. More “Weberian” bureaucracies may then also be better able to promote other policy outcomes, such as those related to disaster preparedness. Similarly, the degree to which bureaucrats are insulated from political interference may affect their ability to implement new policy initiatives.¹⁵

There is a certain tension in this line of argument with the proposal that electoral incentives will drive higher commitments to disaster risk projects because they *do* politicize government action in this arena, whereas it would otherwise be ignored by officials. Here, on the other hand, a Weberian bureaucracy is expected to promote better disaster risk reduction because it is *autonomous* of political interference (breaking the electoral incentives causal chain) but at the same time effective in lobbying the political authority for its own professional vision and securing the funds and authority needed to see it through. These lines of logic are not necessarily irreconcilable, but their relationship with each other and their association with general trends in what is termed political development – consisting of both more electoral competition and more Weberian bureaucracies – will tend to make for a complex analysis.

Moral Hazard

Another key argument in the literature draws on the idea of moral hazard to posit that, “governments underinvest in disaster prevention when they know that they will be bailed out in the event of disaster.”¹⁶ Keefer argues that, “Aid has two potential and offsetting effects. One is to loosen budget constraints that prevent countries from investing in ex ante disaster risk reduction... However, past aid is a signal to countries of the amount of aid that they can receive in the event of a disaster...and countries substitute post-disaster relief for pre-disaster risk reduction.”¹⁷ Raschky and Schwindt provide an empirical test of this hypothesis in the case of earthquakes, storms, and floods. They find evidence to support predominance of a negative aid effect in the case of storms, but the results are ambiguous for floods and earthquakes.¹⁸ These findings suggest both that analysts and practitioners should be cautious in overestimating the negative effects of aid and that there is reason to consider the type of natural shock when evaluating the incentives for investing in preparation and mitigation. The inverse of this hypothesis, that countries not expecting to receive international support in the event of a disaster, will be more likely than others, all else equal, to invest in preparedness, is in some cases referred to as the “pariah” state hypothesis.¹⁹

Civil Society

Civil society organizations (CSOs) are often seen to play a part in promoting, and engaging in, disaster preparedness activities. The presence of local NGOs in a country implies the availability of actors who can directly engage in disaster preparedness and who may have an indirect influence on disaster-related spending through lobbying efforts directed at the national government. In the former case, these organizations may take over responsibilities from the state, either by contract or of their own volition, when state capacity is insufficient. During non-crisis periods this often takes the form of general services such as education and health,²⁰ but civil society actors also engage in activities specific to disaster risk reduction and preparedness.²¹ For these reasons, levels of disaster preparedness may be higher with a stronger civil society presence in general and, in particular, when there are more disaster-oriented NGOs on the ground.

External Actors

A similar argument can be made for the role of international actors in promoting disaster risk reduction and preparedness. Here, entities such as international aid agencies and INGOs may again play both direct and mediated roles in disaster-related activities. Direct actions include implementation of preparedness projects and support of activities by local NGOs. State actors may then learn from these activities and adopt related state-led programs. External actors may also work directly with the national government, supporting activities such as development of risk reduction and preparedness plans, building state disaster management institutions, and funding of related initiatives. In either case, the presence of external actors involved in disaster-related activities is expected to be associated with stronger national disaster preparedness programs.

In addition to international actors, domestic governments may learn from the activities of their neighboring states. Particularly where countries in the same region face similar natural hazards, the disaster preparedness activities of one country may serve as an example to their peers. Under

these circumstances, countries where state leaders are exposed to more developed natural disaster programs in nearby states may also exhibit greater investments in disaster risk management (DRM).

Consolidated Hypotheses

The hypotheses chosen for inclusion in this project, based on review of this and related literature, are summarized here and shown with their sub-hypotheses in Table 1.

- 1) **Perceived risk:** If governments perceive that the risk of a natural hazard is high, then they will invest more in preparedness.
- 2) **Economic strength:** If a country has greater economic resources overall, then it will spend more on disaster preparedness.
- 3) **Electoral incentives and democracy:** If a government perceives disaster preparedness to be electorally beneficial, then it will spend more on preparedness.
- 4) **Political development:** If a government is more developed in terms of the quality of its politicians and the quality and independence of bureaucrats, then it will prepare better for natural hazards.
- 5) **Moral hazard:** If governments anticipate that other actors will spend on preparedness or response, then they will spend less on preparedness.
- 6) **Civil society:** If there is a strong civil society in a country, then there will be greater investment in preparedness.
- 7) **External actors:** If a government has greater exposure to disaster preparedness from the actions of external actors, then it will invest more in preparedness.

Table 1. Hypotheses

This study sought to test the range of existing explanations posited in academic and policy literature regarding national investments in disaster management capacity. Field research gathered empirical evidence to test seven primary explanations, each associated with several sub-components.

Perceived Risk – If governments perceive that the risk of a natural hazard is high, then they will invest more in preparedness.
- If a country has experienced more natural hazards/disasters in the past, then the government will invest more in preparedness.
- If a country anticipates more natural hazards in the future, then it will invest more in preparedness.
- If a country (or region) is small, then it will invest more in preparedness (given the greater threat of a hazard to the country's overall welfare). This encompasses an argument about local areas being more likely to invest in preparedness than central governments.
- If a country is at risk of large natural shocks (but not necessarily frequent), then it will

be more likely to invest in preparedness.
- If the at-risk population is concentrated in smaller areas, less money will be required to offer them the same level of protection, and so less will be spent. This half-conflicts with the smaller country will spend more theory, but only in the geographic sense.
- If the at-risk population is wealthier or more productive than the national average, more money will be spent on DRR to protect them and their contribution to the economy/tax base. If they are a drain on resources, less will be spent.
Economic Strength – If a country has resources to spend on disaster preparedness, then it will be more likely to spend in this area.
- If a country has a higher GDP, then it will be more likely to spend on preparedness.
- If a country receives a large amount of international aid, then it will be more able to spend on preparedness. This contrasts with the moral hazard argument.
- If there is a vibrant market economy, then there will be more investment in preparedness. This will be due to: Market actors pressuring the state to protect their own investments or market actors engaging in their own preparedness activities.
- If a country is constrained in its spending, and preparedness is seen as a substitute to development spending, then the government will spend less on preparedness.
Electoral Incentives and Democracy – If a government perceives disaster preparedness to be electorally beneficial, then it will spend on preparedness.
- If events are rare, then governments will not invest in preparedness, because efforts will be hard to measure and thus electoral benefits will be limited.
- If a government has differing support across regions of a country (including from particular ethnic groups), then it will invest more in preparedness in areas dominated by its supporters.
- If politicians perceive that citizens respond more to disaster response than to preparedness, then they will spend less on preparedness and will spend more if a natural disaster happens.
- If the media gives more attention to preparedness activities (thereby increasing the likelihood of an electoral benefit), then governments will invest more in preparedness.
- If preparedness spending has spillovers into areas that are likely to help politicians electorally, then they will be more likely to invest in preparedness.
- If the population suffers from an acute natural shock, then they are less likely to hold the government responsible than they are for slow-onset disasters, and so governments will invest less in being ready for more acute shocks.
- If a government is in a country with a more advanced democracy, then it will invest more in preparedness.
- If there are competitive elections in a country, then the government will be more likely to invest in preparedness because it is more likely to be held accountable by the population.
Political Development – If a government is more developed (in terms of the quality of politicians and bureaucrats and the independence of bureaucrats), then it will prepare more for disasters.
- If a country's politicians are more corrupt and if international aid flows are more easily diverted into rents than preparedness funds, then the government will be less likely to invest in preparedness.
- In general, if a country has more corrupt politicians and bureaucrats, then they will invest less in preparedness.

- If government agencies are largely insulated from politics, then they will be more likely to engage in preparedness activities.
- If local officials, who have more first-hand knowledge of and exposure to risks, are in control of budgets and projects, then the country as a whole will spend more on preparedness.
Moral Hazard – If governments anticipate that other organizations will spend on preparedness or response, then they will spend less on preparedness (governments will invest in preparedness conditional on their expectations about the preparedness and response activities of others).
- If a country expects international aid in the time of a natural hazard, then it will invest less in preparedness.
- If a country believes that its security situation would deter effective external aid, especially on the ground, then it will invest more in preparedness.
Civil Society – If there is a strong civil society, then there will be greater investment in preparedness.
- If civil society actors pressure the state to invest in preparedness, then the state will invest more.
- If there is a strong civil society, then civil society actors will engage in their own preparedness activities.
- If there are strong local kinship networks, then local actors will invest more in preparedness.
External Actors – If a government has greater exposure to disaster preparedness from the actions of external actors, then it will invest more in preparedness.
- If a state is proximate to states that are investing in preparedness, then it will invest more in preparedness.
- If a state has more exposure to international organizations and non-governmental organizations that promote preparedness, then it will invest more in preparedness.

Study Design/Approach

The findings presented here are based on primary and secondary research conducted on ten African states. The research design utilized a paired comparison model, in which each country was evaluated in conjunction with one other neighboring country. The principal goal was to establish comparisons in which two countries face as similar a set of natural hazards as possible, and often the same specific hazard, so as to facilitate comparisons of the responses by national and local governments to similar hazard profiles.

The selection of countries attempted to include the range of natural hazards typical to the African continent, including drought, floods, and tropical storms or cyclones, and to incorporate countries from across the continent. The resulting country pairs cover all of Africa's Sub-Saharan regions.²² The paired country cases are: Senegal and the Gambia, Ghana and Togo, Ethiopia and Kenya, Malawi and Mozambique, and Zambia and Zimbabwe (see Figure 2).

Figure 2. Ten African Country Case Studies



This study represents one of, if not the, most comprehensive attempts to date to examine the determinants of variation in disaster policies within Africa from a first-hand qualitative perspective. While the findings are to an extent particular to the experiences and types of hazards common in the African context, the conclusions should be more generally relevant to understanding political decision making with regard to disasters elsewhere, especially in other developing countries.

What this design does not do is resolve an inherent problem of small-N research, which is the presence of many potentially important independent variables and an insufficient number of cases with which to test sufficiently each potential cause of variation. What the design does allow for is the expression of expert narrative opinion from within the national, international, NGO, and “ground-level” environments about what is causing national political commitment, resource investment, or institutional effectiveness. To provide the broadest possible set of perspectives, the research team utilized a snowball sampling approach that began with multiple initial starting points in each country and resulted in a wide range of respondents, including politicians, bureaucrats, NGO representatives, academics, and individual citizens.

In order to conduct the analyses, it was necessary to establish a framework for evaluating government capacity to reduce the risks of, prepare for, and respond to natural disasters and investment in this capacity. The Hyogo Framework for Action, established at the World Conference for Disaster Reduction in 2005, serves as the starting point for structuring the analytical work. This framework outlines a set of five overall priorities for countries to shape policies for disaster risk reduction, including effective preparedness and response policies, over the period 2005-15, which are summarized in Table 2. Given the timing of the research in the middle of this implementation period, the Priorities for Action offer a good baseline for

evaluating the progress of countries in this area against an international standard. In addition, initial reports for many African countries provided important secondary data to inform interviews in the field.

Table 2. Hyogo Framework Priorities for Action

Priority	Examples of Activities and Proposed Outcomes
1. Ensure that disaster risk reduction (DRR) is a national and a local priority with a strong institutional basis for implementation	<ul style="list-style-type: none"> - National institutional mechanisms with designated responsibilities - Inclusion of DRR in developing policies and planning - Assessment of human resources and capacities - Foster political commitment to addressing DRR - Community participation
2. Identify, assess, and monitor risks and enhance early warning	<ul style="list-style-type: none"> - Risk assessments and maps - Indicators on DRR and vulnerability - Early warning mechanisms and people-centered information systems - Scientific and technological development including data sharing, space-based earth observations, climate modeling, and forecasting
3. Use knowledge, innovation, and education to build a culture of safety and resilience at all levels	<ul style="list-style-type: none"> - Information sharing and cooperation - Networks across disciplines and regions - Use of standard terminology - Inclusion of DRR in school curricula - Training on DRR for communities and local authorities - Increased public awareness and use of media for public education
4. Reduce the underlying risk factors	<ul style="list-style-type: none"> - Sustainable ecosystems and environmental management - DRR strategies integrated with climate change adaptation - Food security for resilience - Protection of critical public facilities - Recovery schemes and social safety nets - Public private partnerships - Land use planning and building codes - Rural development plans and DRR
5. Strengthen disaster preparedness for effective response at all levels	<ul style="list-style-type: none"> - Increased policy, technical, and institutional disaster management capacities - Dialogue and coordination between disaster managers and development sectors - Regional approaches to disaster response with risk reduction focus - Preparedness and contingency plans - Emergency funds

Source: United Nations International Strategy for Disaster Reduction²³

Evaluating investment in disaster policy specifically is a difficult task, as acknowledged by much of the previous literature. Many studies, such as Rashcky and Schwindt,²⁴ resort to using disaster outcomes such as deaths and damage as proxies for investment. In reporting economic returns for disaster risk reduction projects, Vordzorgbe relies on World Bank-funded projects in Africa as examples and notes that “research on...the costs and benefit of DRR interventions has been limited.”²⁵ While many countries have established specific departments or ministries to oversee disaster-related activities, and the funding for these agencies can in the best cases be determined through public government accounts, the majority of spending that contributes to disaster preparedness activities is likely to go through the budgets of other departments related to building codes and enforcement, education, health, infrastructure, and agriculture. This said, a lack of budget transparency in many states is still a hurdle.

An even larger and more permanent challenge in this type of analysis is the role of dual-use investment, especially in infrastructure, that may not be formally predicated on disaster risk but nevertheless forms the backbone of a country’s ability to cope. Transport networks, sanitation works, economic diversification projects, and local government block grants are all big-ticket items that one might expect to be strong components of disaster resilience but that may not formally form part of a disaster risk reduction budget or strategy. As a result, an understanding of relevant spending in these areas must often be estimated through imprecise discussions with actors involved in disaster-related activities, both state and non-state.

The focus here is on those explicit, dedicated channels of investment whose predominant focus is risk reduction. The research team has done whatever possible to evaluate both explicit funding for disaster-related policies and associated budget items that may contribute to the overall capacity of the state to manage natural hazards. In addition, understanding of investment disparities within countries was leveraged: while the total value of overall investment may be difficult to quantify, interviewees were also prompted to discuss the locations and sectors in the country that were the main focus of attention, gaining insight into institutional priorities and motivations.

Findings

Each of the primary hypotheses is reviewed in the context of the ten countries included in the project, with specific summary evidence to support or refute key elements of each argument. Table 3 highlights the hydrometeorological threats faced by each country, while Table 4 summarizes the team’s assessment of the progress made by each country on priorities of the Hyogo Framework, relative to the other countries included in the study.

Table 3. Types and Levels of Hydrometeorological Threats in Case Study Countries

	<i>Flood</i>	<i>Cyclone</i>	<i>Drought</i>
<i>Ethiopia</i>	Low/Moderate	Minimal	Severe
<i>Kenya</i>	Low/Moderate	Minimal	Severe
<i>Gambia</i>	High	Minimal	Low
<i>Senegal</i>	High	Minimal	High

<i>Ghana</i>	High	Minimal	Moderate
<i>Togo</i>	High	Minimal	Low
<i>Zambia</i>	Moderate	Low	Moderate
<i>Zimbabwe</i>	Moderate	Low	Moderate
<i>Malawi</i>	Severe	Moderate	Moderate/High
<i>Mozambique</i>	Severe	Severe	Moderate
Scale: Minimal, Low, Moderate, High, Severe Source: Scoring is based on country case reports, supplemented by data from the Global Risk Data Platform and UNEP/GRID-Europe.			

Table 4. Progress in Meeting Hyogo Framework Priorities for Disaster Response Capacity

	PRIORITY 1 Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.	PRIORITY 2 Identify, assess, and monitor risks and enhance early warning.	PRIORITY 3 Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.	PRIORITY 4 Reduce the underlying risk factors.	PRIORITY 5 Strengthen disaster preparedness for effective response at all levels.
<i>Ethiopia</i>	4.3	4.3	2.7	3.7	3.3
<i>Kenya</i>	3.0	4.0	3.4	2.6	2.3
<i>Gambia</i>	4.0	2.0	2.8	1.9	2.4
<i>Senegal</i>	3.5	2.8	3.2	2.0	3.1
<i>Ghana</i>	3.3	3.2	2.9	1.9	3.4
<i>Togo</i>	2.5	1.3	2.3	1.1	1.7
<i>Zambia</i>	4.3	3.3	2.8	2.1	3.3
<i>Zimbabwe</i>	2.1	3.0	4.1	1.8	3.0
<i>Malawi</i>	3.4	3.5	3.4	3.4	3.2
<i>Mozambique</i>	3.8	3.3	2.9	3.6	4.3
Scale: 1 to 5, with higher scores implying greater progress on a given goal. Scores are relative to other case study countries. Source: Case study teams' deliberations after country visits produced country scores for each Hyogo priority. ²⁶					

Table 5 summarizes the findings of the ten case studies across all of the major hypotheses considered here. A “+” sign in a cell indicates that the evidence from that country largely supports a given hypothesis, either in its stated form or in the reverse. For example, in the case of economic strength, a “+” may indicate either that the country is reasonably well-endowed economically and it is investing in disaster preparedness activities, or that it is relatively poor and it is not investing in these areas. A “-” sign indicates evidence against a given hypothesis, and a “?” denotes that there was conflicting or insufficient evidence to determine decisively whether or not the case supported the hypothesis.

Table 5. Overall Findings

Potential explanations for why governments vary in their approach to disaster management	Ethiopia	Kenya	Gambia	Senegal	Malawi	Mozambique	Ghana	Togo	Zambia	Zimbabwe
Perceived Risk	+	-	+	+	+	+	+	-	+	+
Moral Hazard	-	+	-	-	-	-	-	-	-	+
Electoral Incentives & Democracy	-	+	+	?	+	+	+	+	+	+
Political Development	+	+	+	+	+	-	+	+	+	+
Civil Society	?	+	-	+	+	-	+	+	?	-
External Actors	+	?	?	+	+	+	+	-	?	?
Economic Strength	-	-	+	+	+	+	+	+	+	+

Perceived Risk

The strongest case can be made for hypotheses emphasizing a relationship between the perceived risk of a natural hazard occurring and the likelihood that a government will institute policies to respond to these hazards and invest in disaster-related activities, as shown through review of the cases considered here. At the same time, the specific activities of governments and the ways in which they are engaging with other actors to implement disaster policies cannot be fully explained through simply an analysis of perceived risk. It is through the investigation of the other established hypotheses in the literature that a more comprehensive understanding of the diverse choices being made by African governments in the face of natural hazards is developed.

The most dramatic cases of perceived risk are perhaps Ethiopia and Mozambique. Prior to the millennium, Mozambique faced somewhat regular annual flooding, but it was not until the dramatic floods of 2000 that the extreme threat of this hazard became clear. The deaths of more than 800 people and the difficulties faced by both the national government and international

actors in responding to the floods contributed to making hydrometeorological hazards a key priority for the national government. Since 2000, and in light of continued annual floods since then, Mozambique has developed a focused disaster management agency, and the interviewees contacted for this project confirmed that the risk of severe flooding has helped to ensure that this body receives clear support from the central government. In Ethiopia, interviewees also linked the long history of droughts and expectation that droughts will continue in the future with the national government's efforts to invest in its preparedness and response capacity.

In Zambia, the threat of regular – but slow onset – hazards such as floods and droughts has been linked to a consistent level of attention to natural hazards over the last two decades. The government's efforts have become more sophisticated since 1994, when initial disaster management policies were put into place (and subsequently revamped in 2010), but in general disaster management efforts have been a consistent part of government policy and have been incorporated into overall development efforts. The Gambia, a country flanking the Gambia river, also faces the persistent threat of natural hazards, in this case flooding. While the government has invested minimal financial capital in disaster preparedness, it has made a concerted effort to develop a disaster management agency that is tasked with developing and implementing relevant policies, and the vice president heads this organization, underscoring high-level government commitment. This example places some pressure on the idea that political commitment and financial commitment will always go hand in hand; however, it is still possible that a strong organizational foundation could pave the way for future concrete investment.

In the neighboring country of Senegal, the government also seems to have increased its attention to natural hazards in light of expectations that these threats, particularly from sea-level rise and flooding, will increase in frequency and magnitude in the future. Interviews suggest that representatives of the government are well aware of these risks, and external actors frequently noted that recent increases in the prevalence of flooding had been closely followed by an uptick in the government's attention to natural hazards. At the same time, the investments made by the Senegalese government often seem ad hoc and focused on response rather than constituting a comprehensive, proactive plan.

Ghana is a case in which persistent historical flooding has been met with a recent increase in the severity of floods. This shift in the degree to which natural hazards threaten the local population seems to have instigated a shift in policy within the national government. While the state had previously been seen as highly reactive and not focused on improving the country's preparedness for natural shocks, approximately half of the interviewees noted a recent shift toward policies attempting to develop a more proactive stance toward disasters.

The cases that offer little evidence in favor of the validity of the hazard perception hypothesis are Togo and Kenya. In Togo, natural shocks have typically been less frequent than in many of the other countries considered here, offering a potential explanation for the lack of attention to these issues in national policy. However, since severe floods in 2007, flooding has become much more common to the extent that interviewees acknowledged a need for a comprehensive disaster management agenda. Yet such an agenda has yet to take shape. For Kenya, the most dangerous type of hazard historically is drought, which has been a threat on a regular basis for many years. It was not until the drought of 2011 that the national government implemented a revised drought

management plan that has been pushed by non-state actors for at least several years. The introduction of the policy in the wake of a particularly destructive drought, but one that followed on years of similar occurrences, suggests that it was the result of factors other than simply perceived risk.

Economic Conditions

In general, the case study evidence supports an argument stressing the importance of strong economic conditions for investments in disaster preparedness and response capacity. Unfortunately, the bulk of the evidence highlights the difficulty African states face to invest in disaster-related policy initiatives due to their weak economic positions. Countries including Ghana, the Gambia, Malawi, Senegal, Zambia, Zimbabwe, and, especially, Togo, have invested relatively low levels of their own capital in preparedness activities. Non-state actors often dominate natural hazard-related spending in these countries, where it occurs. National governments themselves tend to have minimal flexibility to spend their limited resources in an area such as disaster preparedness, where the benefits are often difficult to measure and appear at an unpredictable time in the future. This does not imply that all of these countries are doing nothing with regard to the risks of natural hazards, indeed they are often making important policy strides with the support of external actors, but they are most likely doing less than would be feasible with stronger economies.

Two countries that highlight weaknesses in the economics argument are Kenya and Ethiopia. On one hand, Kenya, despite the highest gross domestic product (GDP) per capita in its region, has invested very few of its own resources in preparedness activities for natural disasters; the Kenyan state relies primarily on external parties for disaster preparedness and response. On the other hand, Ethiopia, a relatively poorer state, has made a much stronger commitment to investing its own resources in efforts to reduce the threat of natural hazards. In these cases, factors other than economics must be considered to explain the outcomes of natural disaster policies.

Electoral Incentives and Democracy

The relevance of democracy and electoral incentives to policy making in the face of natural hazards has been an important focus of recent work in this area and has helped to shed light on political dynamics potentially affecting the lives and livelihoods of individuals living in disaster-prone regions. In particular, this work has helped to highlight the potential negative effects of electoral incentives on disaster policy, as voters are more likely to reward costly and post-hoc disaster response activities than more cost-effective investments in preparedness.²⁷ Additionally, recent research²⁸ has emphasized the importance of accountability, enabled through transparent elections and/or highly institutionalized and responsive party systems, for ensuring that politicians respond in effective ways to acknowledged natural threats.²⁹

Ghana, one of the most democratic countries in the study, provides evidence to support the argument that electoral incentives often encourage governments to spend more on disaster response activities than on preparedness. The Ghanaian public perceives the national disaster management body to be a source of relief and supplies in the wake of natural disasters³⁰ and has responded positively to these actions. However, when the agency has attempted to engage in risk

reduction through moving of at risk populations to less vulnerable parts of the country, the result has been clashes between citizens and the government and the return of many individuals to their original home areas. While the government is attempting to moderate public antipathy toward preparedness activities through recent media campaigns, if voters continue to privilege response actions over preparedness, this is likely to reduce the incentives for the state to pursue similar actions in the future.

Senegal, another relatively democratic country by African standards, provides additional support for the argument that disaster response activities are perceived to provide greater electoral benefits than disaster preparedness. The Senegalese government is more likely to invest directly in response and often does so in the wake of public outcry about a current flooding situation. In contrast, in those areas where there is little media attention to floods, such as in the slum areas of Dakar, floodwater often remains present for months at a time with no government assistance.

The Senegalese case also provides support for a secondary hypothesis on the relationship between disaster-related government investments and electoral incentives. Multiple interviewees noted the politically motivated allocation of disaster relief funds to sub-national regions aligned with the central government. During the municipal elections of 2009, opposition parties overtook the national ruling party to take control of a substantial number of local governments. Subsequent to the elections, the national government decentralized responsibility for flood management; a move that many newly elected leaders felt was an attempt to shift responsibility for a delicate area to the opposition.³¹ Then, in the effort to act on their new responsibilities, many local governments held by the opposition, such as that of Saint-Louis, the “most flooded” city in the world, found it difficult to acquire substantial resources from the central government. This provides the strongest evidence across the cases of a country in which the importance of natural disasters to the voting public is manipulated by the national government for political advantage.

Mozambique presents an interesting case in which electoral incentives seem to play an important role in the behavior of the government, despite the success of the FRELIMO-controlled government in maintaining a largely one-party state at the national level. Since the extreme flooding of 2000, the national government has made a clear and largely effective effort to improve the country’s preparedness for natural disasters. Multiple interviewees noted that there is a sense within the ruling party that, despite their control over the government, if there were another disaster on the scale of that in 2000, then this would put FRELIMO at a significant risk electorally. The fear of this disaster-induced electoral threat has then contributed to the clear investment the government has made in its natural disaster management agency, the INGC, and in developing strong relationships with non-state actors to facilitate implementation of its policy goals. Also, perhaps because past experience has highlighted to both the government and the public the important contribution that preparedness can make in reducing the effects of hydrometeorological hazards, the national policy on natural hazards includes a more substantial set of preparedness components, such as educational programs in communities and schools as well as pre-stocked supply posts in vulnerable areas, than is observed in many other African states.

Countries with more authoritarian regimes, such as Togo, the Gambia, and Zimbabwe, are also among the most limited in their investments in disaster preparedness and response, which is consistent with the electoral hypothesis, though it might not be strong evidence for the hypothesis *per se*, as these are also some of the poorest countries in the sample. Togo does not have an electorally competitive political system or an institutionalized party system that would allow for accountability within the state. The Gnassingbe family has controlled the government for more than 45 years and only in the most recent election of 2010 was there successful multiparty participation that was perceived by the public as a step toward democracy.³² Thus, the lack of substantial investment in preparedness and response is aligned with this electoral environment, as would be predicted by the electoral hypotheses: even if citizens were to demand increased attention to natural hazards, there are few to no electoral levers for them to pull to increase the chances that the government would prioritize these issues. In the Gambia, interviewees noted that voters see regular flooding as a natural phenomenon and do not seem to attribute responsibility to the government. While Zimbabwe seems to have invested relatively more in preparedness and response than Togo and Gambia, there is no evidence that this is due to electoral conditions and in fact the relatively new coalition government, marking a nominal increase in the country's level of democracy, has been associated with no clear policy improvements regarding natural hazards.

Political Development

In general, countries with higher levels of political development—more Weberian bureaucracies, less political interference in the bureaucracy, and lower levels of corruption—are expected to have stronger programs to prepare for and respond to natural shocks. Overall, the findings suggest that this is the case and, perhaps even more importantly, that low levels of political development can reduce the chances for implementation of quality disaster management programs even where other factors should encourage such programs.

Kenya is perhaps the most striking case in which low levels of political development have contributed to the minimal effort exerted by the government to respond to the challenges it faces from natural hazards. The bureaucracy is highly politicized and the cases in which there seem to have been some successes in disaster management, such as with regard to droughts, are attributed to the involvement of agencies led by high-ranking politicians. In most cases, however, the bureaucracy is seen to have been only a minimal contributor and reactive to natural hazards, at best, with NGOs playing a more predominant role in disaster-related activities. This said, it is worth noting that the funds provided by international and non-state agencies to disaster preparedness and response programs are seen to reach their targeted ends, despite perceptions of high corruption levels within the Kenyan state. In this regard, it is perhaps helpful that the bureaucracy is less involved in these efforts, and thus less able to extract rents from the programs that are in place.

Similarly in Togo, the development of the bureaucracy is very low and corruption levels are quite high, according to the Country Policy and Institutional Assessment scores of the African Development Bank from 2009.³³ In Togo, however, the quality of the bureaucracy seems to be less of an issue than the lack of funding for disaster-related programs in general. As one

interviewee noted, there is little corruption in the disaster management arena because there is no funding from which administrators could skim. In neighboring Ghana, while the bureaucracy is in general more developed than that of Togo, high levels of corruption are seen to have impeded implementation and, in particular, enforcement of disaster preparedness efforts to date.

In contrast to these cases, the Ethiopian bureaucracy was found to be reasonably well-developed and able to implement disaster preparedness activities well and without substantial interference from politicians. Additionally, despite scoring poorly on international indicators of corruption,³⁴ a number of interviewees expressed the belief that the bureaucracy was relatively uncorrupt and that skimming of resources intended for natural hazard-related programs was not a substantial problem in the country. In multiple ways, then, Ethiopia's bureaucracy seems better prepared to deal with natural hazards than that of Kenya, Togo, and Ghana. The commitment of Ethiopian government institutions to taking ownership of disaster-related projects does, however, come packaged with the reality that the Ethiopian authorities seek to exercise much greater control over foreign and other non-government actors within the country. This could be read as an example of an aspect of *limited* political development – authoritarian tendencies and suspicion of outside entities – that has actually contributed to the formation of a very proactive role for the bureaucracy in managing resources.

Mozambique offers the strongest evidence against a political development hypothesis. The Mozambican bureaucracy is tightly linked to the ruling party and interviewees noted that it was difficult, if not impossible, to acquire a bureaucratic post without being a member of FRELIMO. Yet the national disaster management agency, INGC, is perceived to be a well-run organization that has led the country's dramatic improvement in disaster preparedness and response. This is not to say that political interests are irrelevant to INGC's operations. Rather, it is more likely that it is the importance of high quality disaster management to the Mozambican state that enables the agency to function well in an otherwise relatively underdeveloped bureaucratic environment. If the national government did not see this issue as a political priority, it is unlikely that Mozambique's bureaucracy would have the capacity to pursue disaster management of its own accord.

Moral Hazard

For the majority of the countries considered here, the findings suggest that the moral hazard hypothesis provides little explanatory value for understanding the behavior of state elites with regard to disaster preparedness and response activities. In Ethiopia, a country that has received substantial international aid in response to natural disasters in the past, the receipt of aid has not minimized government investment in preparedness and response activities and, in contrast, seems to have increased the national government's desire to invest in ways that minimize its dependence on external actors. The government is actively investing in preparedness activities in response to the threat of future droughts and targeting a reduction in its reliance on international food aid, with the goal of independence from international support in this area within the next decade. Similarly in Mozambique, past experience with substantial international intervention during the floods of 2000 helped to instigate activity within the national government to insure both that the country would not face such devastating natural disasters in the future and that the

government would not be reliant on external actors in responding to hydrometeorological hazards.

In Ghana, despite a clear increase in international funding over the last decade (from \$800 million to \$1.6 billion), the government has developed a national contingency plan (in partnership with the UNDP) and allocated \$500 million to disaster response. Alongside substantial investments from international actors in the area of disaster preparedness, the Ghanaian state is contributing its own human and financial resources to develop preparedness strategies. At the same time, the national disaster management agency (NADMO) is seen to require substantial additional funds to fulfill its goals, and Ghana, unlike Ethiopia and Mozambique, seems far from attempting to make itself independent in the arena of natural disasters.

The government of Zambia has relied heavily on international assistance for the majority of its time as an independent country, suggesting that it might be a likely case in which the moral hazard hypothesis would hold weight. This is somewhat difficult to evaluate, because the emergence of a clear disaster management body in the country occurred in parallel with the Hyogo framework and a decline in the relative amount of international aid received. However, there is no reason to assume, nor did interviews reveal, an expectation that the country would not receive support in the wake of a natural disaster. Thus, the efforts to launch a dedicated disaster management body and to use this body to coordinate the activities of donor and NGO activities in the realms of preparedness and response suggest a commitment to issues of disaster preparedness that goes beyond simple reliance on non-state actors.

Malawi provides an even more striking case against a moral hazard argument. The government adopted a disaster preparedness plan as far back as 1991 and has continued to develop its capacity to deal with natural hazards over the subsequent decades. Currently, the majority of funding for disaster management and disaster risk reduction programs is from external sources, but the Malawian government also contributes to these efforts and is seen to play an important role in the overall shaping of disaster-related policy.

In the case of Senegal, the evidence suggests an interaction of moral hazard and electoral effects. With regard to disaster preparedness, the government has invested very little relative to international actors such as the World Bank, which contributed \$15 million for an Integrated Marine and Coastal Resources Management Project, and relative to the government's own investments in large scale public projects such as the African Renaissance Monument. At the same time, the national government has a reasonably strong record of responding in the wake of natural shocks, such as the flooding that occurred in 2008³⁵ for which the state allocated \$13 million for recovery. This is less surprising in light of the relevance electoral considerations seem to have in Senegal. Because citizens are more likely to respond positively to disaster response spending, rather than disaster preparedness,³⁶ the Senegalese government has incentives to allocate spending on response activities, particularly given the willingness of international actors to invest in preparedness activities.

Kenya provides some of the strongest evidence in support of the moral hazard hypothesis. The country receives substantial international aid, \$3.5 billion overall in 2009, and natural disasters

play an important role in perpetuating this assistance. In particular, this research shows both that the national government invests very little in its own preparedness and response activities and that the presence of aid for people living in arid regions of the country reduces the incentives for these individuals to adapt and move away from otherwise unlivable areas. The emphasis of international actors on rural, drought-prone areas is also in contrast to the lack of attention to the need for improved disaster mitigation and preparedness strategies for urban areas, which are at risk due to overpopulation, weak infrastructure, and constraints on access to necessary resources. Neither the international community nor the national government is placing an emphasis on reducing risks in urban areas, despite the majority of interviewees noting the high vulnerability in these areas.

The fact that Kenya is such a focus, and home base, for international organizations (IOs) may contribute both to the perception that moral hazard is a problem and the actual relevance of the dynamic. However, it seems that other characteristics of Kenya's institutional structure are interacting with the strong presence of aid organizations to magnify this problem. In particular, the lack of bureaucratic capacity within the country has led the government to rely on external actors in many areas of service provision, not only in the arena of natural disasters.³⁷ This implies that an important strategy for reducing the relevance of moral hazard may be to focus on improving the development of state institutions in general, so as to increase the capacity of national and local governments to take on responsibilities otherwise adopted by international and local non-state actors. One complicating issue in the Kenyan case is the large number of refugees from neighboring states who comprise some of the most vulnerable people in the country. One might argue that it is more appropriate for IOs to reduce the risks for this population, in which case the Kenyan government's underinvestment could be considered less deserving of a "moral hazard" label. This argument cannot account, however, for the clear lack of attention by the government to disaster risks in urban areas and rural parts of the country less affected by immigration from the north.

For the Gambia, the reverse of the moral hazard hypothesis, or the "pariah" hypothesis, seems to hold weight. Here, many government officials reported that they did not expect to receive substantial aid, particularly relative to the surrounding country of Senegal. While some aid was received from the United Nations Development Program to support the creation of the National Disaster Management Agency, this agency has continued to receive funding, if only small amounts, subsequent to the completion of the UNDP's participation. In contrast, in Togo, there is little evidence to support the pariah hypothesis. Togo has been considered an "aid orphan"³⁸ since the early 1990s, when electoral irregularities and human rights violations caused international donors to withdraw aid support from the country. While aid has increased in the last five years, the government continues not to expect to receive substantial assistance in the form of aid. In the wake of substantial increases in flooding since 2007, however, the government has invested little to no money in disaster preparedness and response. Thus, the expectation that the state will not receive support during a disaster has not led to increased investment in preparedness and response.

The overall evidence from this set of countries suggests that the relevance of the moral hazard hypothesis is limited, at best, and that other characteristics of national environments are relevant

for determining the extent to which national governments will be at risk of succumbing to this dynamic.

Civil Society

Civil society, made up of the non-state and non-market actors active in civic and social activities, is expected to play both direct and indirect roles in influencing the nature of disaster preparedness in a given country. Indirectly, NGOs and CSOs may lobby government actors in an effort to improve the nature of formal policies to prepare for and respond to natural shocks. This type of activity will often require a large number of domestic organizations or organizations representing the interests of large segments of the population. Directly, civil society may contribute in two primary ways, either by engaging in self-directed disaster preparedness activities or by supporting the government through acting as the implementers of state policies. In either case, this may take the form of activities such as community education programs, stockpiling of resources, or providing support to families permanently relocated as a part of risk reduction programs.

Overall, there is mixed evidence to support the civil society hypotheses, and in a few cases there is insufficient evidence to draw a firm conclusion in support of or against the role of civil society actors in affecting overall capacity for disaster preparedness. The states that provide supporting evidence for an argument about the role of civil society are Ghana, Kenya, Malawi, Mozambique, Senegal, and Togo. Perhaps the most striking case is Kenya, for reasons that are also relevant for considering the role of external actors. In Kenya, the government itself has done relatively little to establish a comprehensive framework for disaster preparedness and response and what it has done, such as the creation of a Drought Management Authority and the National Drought Contingency Fund, are seen to be the result of substantial pressure from civil society. At the same time, the predominant role of civil society can mean that the government itself is less technically prepared than CSOs themselves or community actors in areas supported by CSOs. Thus, a strong civil society does not always result in parallel capacity within the government.

Similarly in Senegal, civil society actors, such as local radio and television stations, have devoted considerable attention to documenting natural shocks and attempting to raise public awareness of risks associated with issues such as coastal erosion. Community groups have also pressured the government to invest more in flood management capacities. These efforts seem to have had a moderate effect on government policies, contributing to the introduction of one flood risk reduction plan in 2005. Yet, this is a case where moderate pressure from civil society seems to be associated with moderate government outcomes in terms of preparedness investment: civil society is not as strong in Senegal as in some of the other cases considered here, nor is the government's preparedness capacity robust, but it does exist in some areas and this is at least in part thanks to the actions of civil society actors.

In contrast, the Ethiopian case provides an example of CSOs pressuring government but also acting largely within the framework established by the state. For Ethiopia, CSOs pressure the state to engage in disaster preparedness activities, but they also implement their own programs, as well as the government's, in the context of a disaster risk management program led by the national government. Thus, here CSOs are playing all three roles within a context where the

national government dominates national disaster management strategy and has developed a reasonably strong capacity to implement programs, often through CSOs.

Togo supports an argument about civil society by providing evidence for the reverse of the hypothesis: in a country with minimal civil society presence, less disaster preparedness should be observed, all else equal. The NGOs that do exist in Togo are perceived to have contributed to government-organized preparedness activities since the creation of a national disaster plan in 2007, but they have done little on their own to further the capacity of the state.

The civil society hypotheses received mixed support from Mozambique and Zambia. In Mozambique, the presence of domestic civil society is minimal, but many INGOs have established long-standing domestic presences. These actors also work within the broad framework established by the national government and work closely with the national disaster agency during natural shocks, including daily meetings to coordinate response activities. Similarly in Zambia, a recent NGO Act requires registration of all NGOs and constrains activities to approved areas. At the same time, NGOs often implement programs for the government and are incorporated into the Disaster Management Consultative Forum, in which they can raise concerns or provide information from local sources on areas or communities that may be vulnerable to natural shocks. Thus, while they do not strongly pressure the government to act in certain ways, they can inform policy and play an important role in its implementation.

Gambia and Zimbabwe provide evidence against the civil society hypotheses. In the Gambia, non-state actors seem to place minimal pressure on the state, most likely due to suppression of CSOs by the semi-authoritarian government. CSOs tend to adopt an apolitical stance and do not attempt to pressure the state on policy issues, so as to maintain their ability to engage in other, non-political activities. At the same time, local organizations do play a role in disaster-related programs, but only under the guidance of the state. Similarly in Zimbabwe, NGOs are allowed to act within the country, but they must work within the framework established by the state. While non-state actors may contribute to the government's activities, there is no evidence that they are able to pressure the state to engage in additional disaster preparedness investments.

External Actors

In contrast to the domestic focus of the civil society hypotheses, the external actors hypotheses all concern the role of parties outside the country, such as neighboring states, regional organizations, multilateral and bi-lateral aid agencies, and other IOs. For each type of actor, the hypothesis is that if a country experiences greater exposure to disaster preparedness and risk reduction activities by an external actor, then it will be more likely to invest in its own preparedness. This set of hypotheses, then, is related to the moral hazard hypotheses. In the case of moral hazard, direct investment, or expected investment, by international actors in *response* is expected to reduce the degree to which states invest in *preparedness* activities. In this case, investment by external actors in *preparedness*, either in their own domain or within the country in question, is thought to *increase* the likelihood of domestic preparedness spending. The relationship between these hypotheses is considered in greater detail in the discussion section below. Overall, there is either supporting or mixed evidence for the external actors hypotheses.

The most common way in which external actors have influenced national preparedness activities in the study cases is through partnerships between IOs and INGOs and state actors to develop DRR and DRM plans and institutions. In Ghana, the nodal disaster management organization, NADMO, has a close working relationship with the UNDP, which has helped the government to develop a disaster risk reduction plan and to implement a range of prevention activities, including regional disaster management plans, guides for building, and the mainstreaming of DRR into broader development planning. While the activities of neighboring states, such as Togo, have had little influence on DRM strategies in Ghana, IOs are playing a critical role. The UNDP played a similar role in the Gambia, working with the government to develop a national disaster management framework and to create the National Development Management Agency (NDMA). Since its introduction, the NDMA has continued to work with multilateral agencies both to design preparedness activities and to assess natural shocks as they emerge. In Ethiopia, the government also frequently draws on the international community for preparedness information and resources. Indeed, for many years, IOs and NGOs led preparedness activities, but recently the government has been taking more of a leadership role, while still relying on external actors to support their activities. In either case, the role of these organizations in fostering DRM has been an important element of the country's preparedness.

In other countries, such as Zimbabwe, the national government has less exposure to international actors with an interest in natural disaster management. While there are many INGOs acting in the country, only a small number have an explicit focus on preparedness activities, thus offering few examples from which government actors can learn. The efforts that the Zimbabwean government has put forth with regard to disaster preparedness, then, should not be attributed to the influence of external parties. Zimbabwe's neighbor, Zambia, provides a similar example, in which minimal attention from international agencies, relative to other countries in the study, suggests a limited causal role for external actors. While representatives in Zambia noted that the national disaster risk reduction platform initially drew from the experience of South Africa, they also argued that the Zambian approach has now gone beyond what is done by its southern peer. In this way the Zambian and Zimbabwean cases do not contradict the argument, as there is evidence of some preparedness activity in each country, but this activity cannot be attributed to the influence of external actors.

Only in Togo is there evidence against the role of external actors in shaping preparedness investment by the state. Despite Ghana's more aggressive strategy for developing preparedness capacity, its neighbor has adopted few similar measures. For the most part, external actors lead the minimal preparedness activities that do occur in Togo. Yet, despite these investments by international actors, the government has not pursued additional preparedness activities of its own. In this case, it seems that international actors in general play little role in preparedness investments.

Application of Results

The analysis above helps to highlight the relative strength of each hypothesis for explaining variation in national efforts to promote preparedness for natural hazards and to reduce the risk of these shocks occurring. It is also relevant to consider the ways in which an evaluation of this

range of hypotheses has helped us to gain a more comprehensive understanding of the opportunities and constraints faced by countries attempting their disaster management capacities. No single hypothesis offers a consistent and deterministic explanation for observed policy outcomes, however the combination of characteristics emphasized by multiple hypotheses can provide what is likely to be a reliable set of expectations regarding the propensity of states to invest in disaster preparedness.

The two clearest predictors of investment in preparedness activities are economic strength and perceived risk of natural threats. States that expect to face natural hazards in the future, particularly as a result of having faced them in the past, and that have the economic resources available to dedicate toward these risks, are more likely than their less threatened and poorer peers to invest in disaster preparedness.

However, economic strength and perceived risk on their own are apt to mean very little when there is limited electoral incentive or bureaucratic capacity to implement substantial preparedness operations. Funds will be wasted, or misdirected, if there is not an institutional structure to facilitate the implementation of disaster management programs. Kenya is perhaps the best example of this, a relatively well-off country economically that faces regular natural hazards, but that has failed to implement substantial preparedness programs in large part due to the lack of political development within the state. Thus, the nature of electoral conditions and political development help us to understand whether governments have the *incentive* to invest in preparedness activities and whether they have the institutional *capacity* to do so. On the one hand, where these conditions do not hold, there should be fewer efforts to invest in disaster management, even where financial resources are available. On the other hand, where this is the case, there should be efforts to promote preparedness multiplied when there are also economic resources and perceived risks as well as greater efforts to invest in preparedness than might otherwise be expected if perceived risk and financial resources are low.

The acts of governments also cannot be fully understood without attention to the role of non-state actors. In many poorer countries, governments are still often attempting to build capacity to prepare for natural threats. In these cases, preparedness activities are often supported by external actors, such as IOs and both international and domestic NGOs. It is the explicit focus on *both* preparedness and response, when a shock does occur, by these non-state actors that seems to limit the relevance of the moral hazard argument in the majority of cases considered here. When external agencies engage with national governments to promote preparedness, this effectively nullifies the ability of these states not to invest in preparedness while relying on external actors to provide aid for response.

With regard to domestic civil society in particular, its effects on national investments in capacity are often only relevant on the margins, but the same cannot be said for the role of civil society in contributing to overall national capacity in the face of natural hazards. NGOs are often the main actors implementing government plans to increase awareness and preparedness for natural shocks. Where governments do not have their own disaster preparedness programs, these organizations serve as the primary actors in building national capacities to deal with natural shocks. In countries without these actors on the ground, the countries considered here are considerably more constrained in their abilities to manage the risks of natural disasters.

External actors, such as the UNDP, on the other hand, often play a direct role in providing funding and personnel for preparedness activities, working in close coordination with national governments. These activities may not result in increased financial investment on the part of states, but do require the investment of time, personnel, and political capital that contribute to the development of domestic capacities related to disaster management. Thus, attention to the role of external actors can also help to explain the presence of disaster management capacity in states that might otherwise not be expected to have such resources.

Conclusions

Disasters by definition overwhelm the immediate ability of human beings to absorb a shock and move on as before. They have always been known to be chaotic in the popular meaning of the term, disrupting orderly human systems and instilling a fear and desperation that can upend normal patterns of understanding. But are they also destined to be chaotic in the mathematical sense? In other words, are the outcomes of natural shocks ruled more by the broad sweep of structures, well captured by an explicit political and economic narrative? Or are lives and livelihoods ultimately at the mercy of differences in initial conditions that are so small, so variant between disasters, and so subtly hidden among mountains of plausible explanations that researchers have little hope of pinning them down and proposing policy intervention?

Quantitative models that give a comprehensive view of the important control variables – natural hazard magnitude and end-state human consequences – are still in their relative infancy, and the precision needed to perform predictive and inferential modeling that is good enough to justify serious counter-intuitive commitments of resources is still lacking. Even when these arrive, it will require a heroic effort of science to disentangle variables that are reinforcing, canceling, or switching each other on or off in innumerable and intricate ways.

But it is clear that in times of natural disruption, wealthy societies with advanced disaster risk reduction and management capacity draw not only on individual reserves but also on pooled resources of expertise, material, and authority. The structure of these pooled resources is determined by political will and funding and explained in a political and institutional narrative. Regardless of whether central institutions that reduce risks and act as pooled emergency resources have the same impact in developing nations as they do in developed ones, central capacity is a vital part of understanding disaster. Capturing that political and institutional process from as many perspectives as possible provides much-needed insight, even if it is not feasible at this time to assign it a numerical value in terms of how many lives are saved when institutions advance.

Indeed, what is most compelling from this qualitative perspective is that national institutions are emerging from clear structural foundations. Better institutional capacity is not merely something that appears to be *accompanying* development via myriad hidden and chaotic processes. Rather, institutions are being built up according to a visible and explicit political narrative that can be readily identified and coherently critiqued by stakeholders on the ground. In each country, the evidence shows that it is also possible to identify large-scale precursor conditions that are seen to

have been relevant in giving rise to the current situation. These are not perfectly consistent *across* borders, giving us a hint that subtle, more chaotic factors may always continue to hound the predictive aspirations of this field. But they do *tend* toward agreement with the common sense of established hypotheses in the research literature. And where they do not, the findings do not offer new mysteries, but rather clear alternative explanations rooted in the recent history of those states and articulated by local actors.

This research contributes to the larger pursuit of good predictors for disaster vulnerability, which is becoming ever more urgent as international actors struggle with the allocation of resources to offset climate-change-related risks. It explicitly targets institutional capacity at a national policy and bureaucratic level. It does so while recognizing that there are numerous and inter-linked causal chains between country conditions and disaster outcomes that lead not just through national institutions, but also through households, international aid actors, higher-level constitutional structures, and the whims of Mother Nature. The work presented here is an important reminder that it is a set of existing political economic conditions, not a new pattern of natural hazards, that shapes national capacities to manage and prepare for natural shocks.

Endnotes

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²⁰ Lauren M. MacLean, “State Retrenchment and the Exercise of Citizenship in Africa,” *Comparative Political Studies* 44, 9 (2011): 1238-1266; Jennifer N. Brass, “Blurring Boundaries: The Integration of NGOs into Governance in Kenya,” *Governance* 25, 2 (2012): 209-235.

²¹ Katrina M. Allen, “Community-based Disaster Preparedness and Climate Adaptation: Local Capacity-building in the Philippines,” *Disasters* 30, 1 (2006): 81-101.

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²³ United Nations International Strategy for Disaster Reduction, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* (New York: United Nations, 2005).

²⁴ Rashky and Schwindt, 2009.

²⁵ Seth Doe Vordzorgbe, “Making the Case for Disaster Risk Reduction in Africa” (Nairobi: UNISDR, 2006): 15.

²⁶ Case study teams’ deliberations after country visits produced country scores for each Hyogo priority on elements specified by the Hyogo Protocol pursuant to that priority. Separate deliberations designated capacity in each main priority area as “weak, moderate, or strong.” The two types of evaluations were then averaged, with the 1-5 scoring average weighted 2x and the categorical designation weighted 1x, using weak=1, moderate=3, and strong=5. For Malawi, only subscore averages were used: no categorical capacity designations (weak/medium/strong) were generated.

²⁷ Healy and Malhotra, 2009.

²⁸ Keefer et al., 2011.

²⁹ This implicitly raises the issue of culture as a mediator between disaster suffering and electoral pressure. The extent to which ordinary citizens will hold the government responsible for the outcome of a “natural” disaster may vary widely given fairly nuanced differences in history and society. In Gambia, individuals affected by floods did not necessarily view the government as accountable for the damages to their homes and property, whereas in Senegal there was significant diversity in public opinion about the role for the government in managing disasters. While these variations are accounted for where possible, public opinion on natural disasters is on its own a significant area that requires further research across countries.

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Chapter 8. Climate Change Resilience in Urban Africa

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Executive Summary

This research under the CCAPS program examines the capacity of governmental systems to prepare for and respond to climate change and climate-related hazards in a set of large urban areas in Africa. The project gives priority to the role of local government in developing resilience due to its key role in addressing urban vulnerabilities through the provision of local infrastructure and public services, promulgation and regulation of land use and building codes, and other local services that are crucial for effective adaptation to climate change. Although local government capacity in African cities has generally improved in recent decades, the priority for state reform in Africa has been primarily focused on national governments and political legitimacy. While many countries have developed, or are developing, national climate adaptation plans, efforts to systematically address adaptation at the local level frequently face the challenge of collaboration among multiple local government jurisdictions with limited capacity. To investigate local government efforts in building resilience to climate change, this project adopts a comparative case study method examining 10 highly diverse, major African cities: Accra, Ghana; Alexandria, Egypt; Cape Town, South Africa; Casablanca, Morocco; Dakar, Senegal; Dar es Salaam, Tanzania; Johannesburg, South Africa; Kampala, Uganda; Luanda, Angola; and Maputo, Mozambique.

Introduction

Climate change and its potential effects are increasingly important concerns to the scientific community, governments, international organizations, and exposed populations around the world. Over several decades, efforts to adapt to the changing climate have expanded. No regions of the world are unaffected by climate change, and residents of urban areas in low- and middle-income countries are particularly vulnerable. This vulnerability stems from high rates of urbanization coupled with poor urban planning, gaps in public services and infrastructure, settlement in hazard-prone areas, and high levels of poverty, illiteracy, and poor health. These factors are particularly pressing on the African continent, where development and governance challenges result in low adaptive capacity. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) identifies Africa as “one of the most vulnerable continents to climate change and climate variability”¹ due partly to climate exposure, but also to low adaptive capacity and high vulnerability to climate-related hazards such as flooding, drought, and sea-level rise.²

In recent years, climate-related hazards in Africa have significantly impacted both human and natural systems, and it is expected that climate change will both increase and intensify these impacts in the future. In 2009, flooding in Dakar caused more than US \$103 million dollars in property loss,³ and in Lagos in 2012, flooding killed 140 people and displaced 623,900. Such flooding events are expected to increase in frequency and severity in many cities across Africa, especially in coastal cities as temperature increases lead to sea-level rise. In addition, projections

to 2050 suggest that as many as 600 million people in Africa could be affected by drought.⁴ While national governments, international organizations, non-governmental organizations (NGOs), and other actors are currently involved in efforts to respond to these hazards, limited adaptive capacity often results in inadequate preparation and limits effective response.

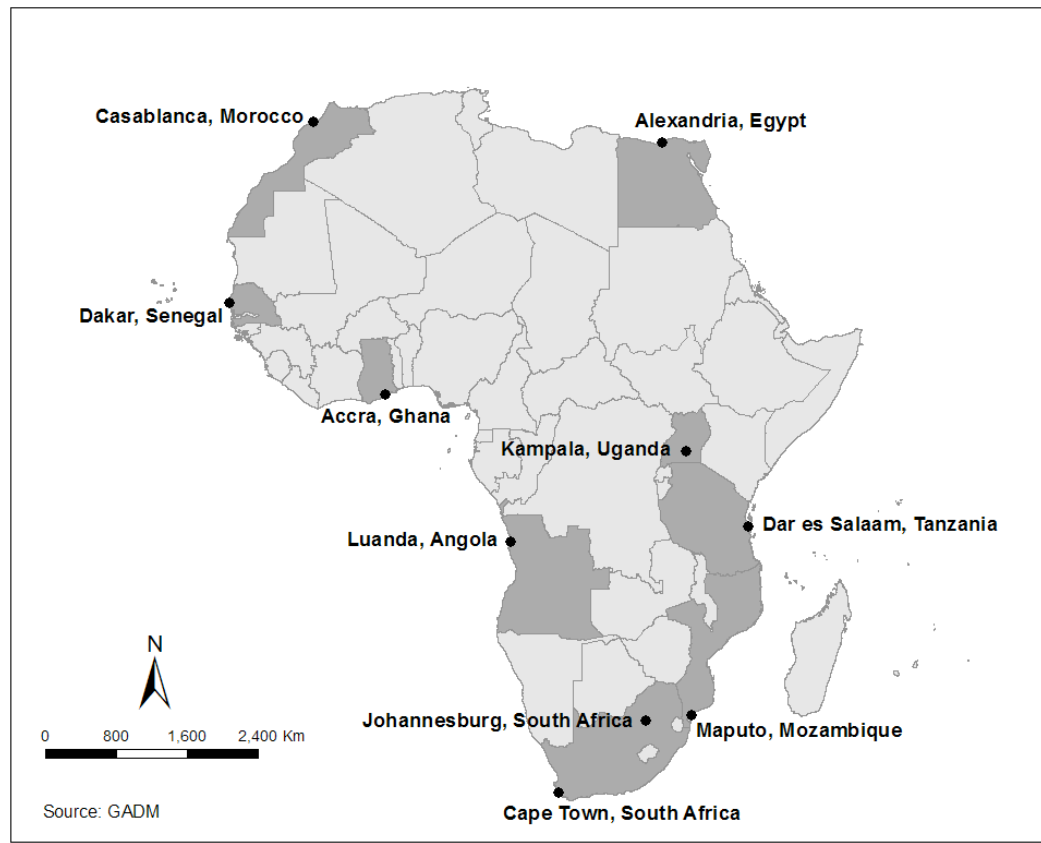
The policy domain of climate change is complex, both with respect to climate change science, projected impacts, and to the governmental/institutional framework for policy discussions and actions. The terminology used in climate change policy discussions is also complex, and disagreements often exist over the definitions of such important terms as resilience and adaptation. The term resilience has come to be increasingly used in policy discussions,⁵ even though disagreements exist over its precise meaning, at least in academic communities.⁶ The United Nations Office for Disaster Risk Reduction (UNISDR) defines resilience as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.”⁷ Adaptation is defined as “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.”⁸ This project largely adopts these definitions, but with the understanding that in practice these concepts are highly interdependent. In other words, building resilience in the face of climate change refers to the ability of communities and cities not only to respond to and absorb the effects of individual potentially disruptive weather-related events, but also to sustain this ability in the face of climate change that may increase the frequency or intensity of such events in the future.

Project Purpose

This research examines the capacity of governmental systems to prepare for and respond to climate change and climate-related hazards in a set of large urban areas in Africa. The project gives priority to the role of local government in developing resilience due to its key role in addressing urban vulnerabilities through the provision of local infrastructure and public services, promulgation and regulation of land use and building codes, and other local services that are crucial for effective adaptation to climate change. Although local government capacity in African cities has generally improved in recent decades, the priority for state reform in Africa has been primarily focused on national governments and political legitimacy.⁹ While many countries have developed, or are developing, national climate adaptation plans, efforts to systematically address adaptation at the local level frequently face the challenge of collaboration among multiple local government jurisdictions with limited capacity.

To investigate local government efforts in building resilience to climate change, this project adopts a comparative case study method examining 10 highly diverse, major African cities: Accra, Ghana; Alexandria, Egypt; Cape Town, South Africa; Casablanca, Morocco; Dakar, Senegal; Dar es Salaam, Tanzania; Johannesburg, South Africa; Kampala, Uganda; Luanda, Angola; and Maputo, Mozambique (see Figure 1).

Figure 1. Map of Selected Cities



Study Design/Approach

The importance of addressing urban vulnerabilities to climate change within national and local level climate change policies is increasingly being recognized around the world. Among African countries, climate change policy efforts have generally been initiated at the national level, often with a priority on vulnerabilities in rural areas where the majority of their populations still reside. Although a few local governments in major African cities are well known for their climate change adaptation efforts (e.g. Durban and Cape Town in South Africa), in most cities, building resilience to climate change is incipient, at best, and must compete with other more critical development priorities on local policy agendas. This exploratory study seeks to assess, based on current practice, the ability of the governance systems in large cities in Africa to develop the resilience needed to effectively prepare for and respond to a set of prominent climate hazards.

Research Questions

1. How will the consequences of future climate change affect people living in African cities, and what determines the vulnerability to these exposures?

The question has two primary dimensions. First is the identification of the projected impacts of future climate change in cities, including exposure to specific climate hazards such as flooding, storms, sea-level rise, drought, and water scarcity. Second is the identification of the physical,

social, economic, and political factors that contribute to a city's vulnerability to these impacts and hazards. Factors related to both the natural and built environment, such as topography, geology, ecosystems, infrastructure, and settlement patterns can affect vulnerability. High population density and concentration of economic assets in cities can also increase vulnerability. In addition, the ability of local governments to effectively plan the city and enforce land use and other policies can either increase or decrease the vulnerability of the city's population. Given the socioeconomic diversity and geomorphic variation in Africa's major cities, the level of vulnerability can vary across different areas of a city. Equally important is that different climate hazards can generate different types of vulnerability.

2. How does the development of policies, plans, and initiatives to build urban resilience to climate change vary across urban areas and hazard type, and what factors explain the variation?

Having established the potential consequences of climate change in the first question, this question examines the development of policies and initiatives to respond to particular hazards and vulnerabilities. While the focus is on local governments and city level policy, it is expected that both national governments and international organizations will play pivotal roles in local government policymaking. Recognizing that building resilience to climate change represents an emerging policy challenge, one that all local governments may – at least explicitly – not address, the research will cast a broader net and identify a range of local initiatives that address climate hazards, such as flood management measures as an element of a disaster risk management strategy. While these strategies may not explicitly target climate change issues, they are building the city's resilience to respond to hazards that will likely be exacerbated by climate change. This question will also explore whether initiatives target particular areas of the city or certain population groups based on local vulnerabilities, consider the influence of national governments on local policy, and identify the range of actors engaged in the issue.

3. Are these initiatives to build resilience being adequately and sustainably implemented by the relevant actors and networks, and what factors impact the efficacy for such initiatives? What resources are available for improving the effectiveness of resilience initiatives?

While the second research question addresses the development of initiatives, the third question examines their implementation and effectiveness. Again, the focus is broad and includes initiatives relevant to vulnerability and resilience that may not have been adopted to address, explicitly, climate change. For example, what are the existing capabilities of local governments to improve urban planning, infrastructure and service provision, and environmental management, as well as other local government responsibilities that have a direct effect on vulnerability? What are the technical and resource capacities of local governments and how do these affect current capabilities? If the local government lacks the capacity to address vulnerabilities, are other actors, such as NGOs or community-based organizations, helping to build resilience? And how can a city's existing resources and institutional capacity be mobilized to improve implementation?

To address these research questions, an exploratory comparative case study methodology, with individual cities serving as the cases, was chosen. Drawing upon the findings from individual

cities, comparisons across cities are used to identify patterns that help answer the research questions. The comparative case study methodology provides the opportunity to assess how governmental structure and the powers of local government affect urban resilience initiatives but offers the flexibility to devote additional attention to those aspects of a city that are particularly important in explaining these initiatives.

The decision to limit the study to large cities in Africa was based on the expectation that large cities would have particularly complex exposure and vulnerability profiles due to the prevalence of informal settlements and economic assets of national importance. It is also the case that the complex institutional contexts resulting from the existence of multiple local governments in a single urban agglomeration raise the opportunity to examine issues of local government coordination that are less likely present in rural or smaller urban areas.

The first step in the selection process identified a pool of 38 urban agglomerations in Africa with populations of 1.5 million or more according to *The Principal Agglomerations of the World*.¹⁰ The research team applied four criteria to the 38 urban agglomerations, seeking variation on each in the set of cities selected:

1. Climate hazards to which the city is exposed;
2. Geographic location, region of the continent, and coastal and inland cities;
3. Colonial legacy and institutional development; and
4. Socio-economic conditions and level of development.

Hazard type was chosen as a major criterion with the expectation that it could affect local policymaking: first, adaptation strategies differ across hazard type; second, different hazards generate different types of vulnerabilities; and third, different hazards have different onset times. Therefore, it was hypothesized that resilience efforts in the cities would vary according to each city's unique hazard profile. This creates, methodologically, the opportunity to contrast resilience strategies across hazard type, thus, addressing one of the key research questions.

Drawing from earlier CCAPS research,¹¹ hazard profiles of the geographic area in which each city is located were developed. The pool of cities was narrowed to those with high exposure scores or exposure to multiple climate hazards. University travel restrictions, due to safety concerns, further restricted the pool of cities. Given that coastal cities tended to have higher hazard scores, several inland cities were intentionally retained in the pool to ensure variation in hazard type. Having reduced the number of eligible cities, the remaining factors—institutional development and governance capacity—were applied in order to find variation across governance capacity and level of development. For example, given the comparable hazard profiles of many coastal West African cities, Accra and Dakar were selected because they developed from different colonial legacies and represent different institutional practices. (The set of selected cities and the relative exposure of the geographic area in which each city is located are provided in Table 1.)

Table 1
Expected City Hazard Exposure

City	Storms	Flood	Wildfire	Low elevation	Drought	Chronic Aridity	Total Exposure*
Alexandria	0	0	4	5	3	4	12.5
Maputo	0	3	1	3	4	4	11
Dar es Salaam	0	3	0	5	1	2	9.5
Casablanca	0	2	0	3	4	4	9
Cape Town	0	2	3	1	2	3	8.5
Luanda	0	1	0	4	1	5	8
Dakar	0	2	0	2	1	3	6
Johannesburg	0	1	2	0	2	2	5
Accra	0	1	0	0	5	2	4.5
Kampala	0	1	0	0	5	1	4

Source: Joshua Busby et al., *Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?*, CCAPS Working Paper (Austin: Robert S. Strauss Center for International Security and Law, 2010); Joshua Busby et al., “Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?,” in *Climate Change, Human Security and Violent Conflict*, vol. 8, Hexagon Series on Human and Environmental Security and Peace, 2012, 463–512. *Note: Total exposure = Storms + Flood + Wildfire + (Drought + Chronic Aridity) / 2. Drought and chronic aridity are two different measures of water scarcity.

Research teams were assigned to each city and city profiles developed. A set of interview questions reflecting the three research questions was generated and sets of targeted interviewees, including local, regional, and national government agencies, as well as multilateral and bilateral organizations, university researchers, and non-profit and community-based organizations, were identified. The field research was conducted in December 2012, with the exception of Alexandria, which was conducted in March 2013. Each city team conducted between nine and twenty interviews.¹²

Findings

This project conducted an assessment of the engagement of local governance systems in large African cities in developing the resilience needed to face climate change challenges and, thereby, enhance the collective well-being of their populations. The comparative case study method applied in 10 large African cities provided the authors discretion in exploring the unique circumstances of local governance systems and their approaches to addressing the consequences of climate change. Although a common set of questions was addressed in each city, the differing institutional settings, climate exposures, and vulnerabilities lead to distinct narratives. While this methodology limits the ability to generalize these findings to other African cities, the findings are sufficiently robust to merit consideration by the multiple policy communities. In addition, the exceptions, in individual cities, to the broad findings provide additional insights to understanding the existing state of play in climate change adaptation efforts in urban Africa.

Climate Change Exposures and Vulnerability in Urban Africa

Climate change exposure—the result of location in a hazard zone that puts people, property, and systems at the risk of losses as a result of a climate event—was confirmed to be significant in each of the 10 cities examined here. But as anticipated, the degree of exposure to the three hazards examined here, flooding, water scarcity, and sea-level rise, varied significantly across the 10 cities. Vulnerability is affected by the characteristics of human systems, including the built environment, that contribute to establishing the level of harm (damage) that can accrue during a climate event. Although the vulnerability profiles of the 10 cities had some common elements, such as the presence of informal settlements, the relative importance of the factors producing the profiles varied among the cities. Nevertheless, a general conclusion of the research indicates that the combination of exposure and high vulnerability due to the characteristics of settlement patterns and populations as well as low adaptive capacity make Africa particularly vulnerable to the impacts of climate change.

Exposures

A growing body of knowledge concerning climate hazards in Africa indicates that weather patterns across the continent generate different levels of exposure. Even though much of Africa will have less precipitation, the intensity of storms is projected to increase. Storm events take a variety of forms (including wind, sand, hail, and flooding) and are often seasonal in nature. Storms and flooding were by far the most commonly identified and greatest perceived threats in the 10 cities. The relative regularity of storm and flood events and their visibility and destructive capacity make disaster response and public safety a priority of local governments. Their relatively frequent occurrence over recent decades draws attention from the possible extenuating effects of climate change. That is to say, cities are engaged in disaster risk reduction for flooding without necessarily being motivated by a concern for climate change.

Despite the significant exposures to flooding in most of the cities examined here, many also face the risk of water scarcity and drought. These hazards have slower onset times than flooding, and their effects are often more distributed over a city and region. For example, urban water supply may originate in river basins at a significant distance from the city. An illustrative example is observed in Alexandria, where the Nile River provides the needed five million cubic meters of water per day. Despite projections of substantial increases in water demand in coming decades, water scarcity is not found on the city's agenda since shortages do not presently exist. Should the Nile's supply be disrupted, however, the need will become more urgent. Slow-onset threats, like drought and water scarcity, can be difficult to predict, identify, and prepare for. In addition, a local government in a city will likely have no authority of water management in a distant region. As urban populations continue to expand, local governments will experience even greater strains on local and regional water resources.

Rising sea levels pose a significant threat to Africa's coastal cities, especially the eight fast-growing coastal cities examined in this project. The low-lying or coastal areas that often house growing residential populations are prone to flooding and storm surge that will accompany sea-level rise in coming decades. The very substantial economic assets in their ports and coastal industries are at risk. The World Bank identifies coastal erosion and marine submersion as

Alexandria's most pressing environmental risks, although these risks have not been given a high priority by local government. Researchers have identified coastal erosion and saltwater intrusion as the greatest climate threat to Dar es Salaam, but these are yet to be addressed by city government. Similarly, the implications found in Cape Town's coastal risk assessment have yet to be effectively utilized in planning for sea-level rise. Much like drought and water scarcity, sea-level rise is a slow-onset hazard and has, to date, received less attention at the local level.

The uncertainty surrounding climate projections needs to be re-emphasized. Projections of increased variability and intensity of precipitation events throughout the continent are expected to result in heavy rainfall in eastern Africa; drying and drought in northern, western, and southern Africa; and sea-level rise along all coastal areas, especially in North Africa. But climate-modeling tools are more effective at modeling the magnitude and distribution of global temperature change than in modeling precipitation. The error associated with climate models is compounded by a lack of research and climate data on local conditions in Africa. Though inadequate, knowledge about exposures is increasing, and the study found attention being devoted to scientific and technical knowledge about exposures in several cities. In fact, the importance of region specific knowledge of exposures, as frequently found in urban risk assessments, is a necessary element for developing effective resilience policies. Although this locally generated knowledge is not yet being adequately incorporated into local resilience policy, for reasons discussed below, improvement in the understanding of local exposures is a promising development.

Human-Created Sources of Vulnerability

Expected impacts of weather-related hazards depend upon a location's degree of exposure to a hazard (e.g. high elevations are not exposed to sea-level rise) and to level of vulnerability at that location. As a result, vulnerability varies by hazard type and by geographic location. For most of the 10 cities studied here, the interaction of exposure to hazards and characteristics of geographic location is pernicious. Vulnerabilities are likely to increase in coming decades.

Location. Geographic location and topography substantially contribute to vulnerability. Cape Town is at risk for storm surge and experienced significant coastal erosion during a powerful 2008 storm. Dakar sits on a peninsula that extends into the Atlantic Ocean, the most western point of mainland Africa. Every coastal city in this study is, to some extent, vulnerable to the effects of sea-level rise. Rising sea levels will have a dramatic impact on industry (especially ports), residential communities, and tourism. But inland cities, such as Kampala, may also be subject to riverine and localized urban flooding. The North African cities of Casablanca and Alexandria experience arid climate conditions and are more exposed to the hazard of drought, and Johannesburg, situated between two river basins, is reliant on inter-basin transfers for its water supply making it particularly vulnerable to water shortages.

Historical Settlement Patterns, Colonial Influences, and Political Instability. The realities of urban life can dramatically increase vulnerability to climate hazards. Each of these major African cities has areas of high densities of poor residential populations. Past urban development practices, especially urban planning practices, have exacerbated vulnerability in these 10 cities. Most cities in this study continue to be heavily influenced by decisions made by colonial

planning systems. The South African cities of Cape Town and Johannesburg grew under the system of racial separation established by the British colonial government and continued under the apartheid system of the National Party government, resulting in low residential densities in the cities' centers and higher-density, low-income areas in the cities' periphery and townships. Land tenure systems create uncertainty surrounding land ownership in some cities. For example, in Accra, tribal authorities often control the distribution and use of large tracts of land. The lack of clear and unencumbered land titles can constrain investments in public infrastructure as well as in private residences.

Political and armed conflict can also affect urban vulnerabilities in indirect ways. The extended conflict in northern Uganda ended in 2006, but left a legacy of substantial rural-to-urban migration. Angola's civil war lasted until 2002 and caused tremendous internal displacement. Rural conflict, due to resource scarcity and other issues, can drive migration into urban areas. Egypt's ongoing revolutionary climate creates uncertainty around governmental capacity to manage urban development and strengthen local governments.

Asset Exposure. Many of these cities assumed roles as transportation hubs in the context of colonization and they have grown into major centers of economic activity and population, with substantial fixed investments in infrastructure and other economic assets. The Johannesburg area accounts for nine percent of the GDP of the entire continent. Major economic interests and assets in Senegal are concentrated in Dakar, a city uniquely exposed at the tip of a peninsula. The ports in coastal cities are especially vulnerable to storm events and sea-level rise. In addition, tourism is a common and essential industry in many of Africa's major coastal cities. The concentration of economic and physical assets further heightens vulnerability in these cities, especially to sea-level rise of the coastal cities.

Urban Planning and Building Regulations. Deficiencies in land use and transportation planning, infrastructure, drainage, and sanitation are common problems among many of the cities in this study and exacerbate vulnerabilities. The extent to which infrastructure serves residential populations varies across the cities, related in part to levels of national development. Alexandria, Cape Town, and Johannesburg—cities in middle-income countries—exhibit better infrastructure coverage than in the other seven cities in lesser-developed countries. Growing populations further strain urban services, including drainage, waste collection, and disaster response systems, that are crucial elements for resiliency. If drainage pipes and channels are too small or non-existent, relatively minor precipitation events can lead to flooding. Even with sufficient drainage systems, inadequate waste management can result in trash blocking the flow of water.¹³

Vulnerabilities are further accentuated by poorly regulated urban development. For example, the local government of Dar es Salaam has been without a comprehensive city plan for an extended period. In Accra, some residents have reported waiting almost 10 years for a building permit, often resulting in unregulated construction before permits are received. In Casablanca, land-use regulations for riverbeds and coastal areas are often disregarded by both informal settlers and businesses. Kampala's drainage system, built in 1960 and sized for the population of that period, 137,000, is ill-equipped to serve today's 1.7 million residents. Economic interests often trump zoning concerns, resulting in high-cost residential buildings constructed on the city's coastline that is vulnerable to erosion.

All cities in this study are experiencing rapid population growth increasing land values. Even though land just beyond the periphery of cities is being converted to urban uses, the housing supply cannot keep pace with the population increase. Growth pressures lead to settlements in areas previously deemed unfit for development, such as on wetlands, in floodplains or natural drainage corridors, and on sandy soil with foundations that may be swept during flood events, thereby aggravating existing vulnerabilities. Zoning regulations may prohibit settlement and development in vulnerable areas but are too often not enforced. The loss of wetlands in Kampala due to urban development, for example, exacerbates flooding. Paving over previously permeable natural areas will also disrupt the natural absorption of water, and if development occurs over river and creeks, it can block natural outlets for water and create regular flooding. Development in coastal areas can increase coastal erosion and development in coastal wetlands can compound the effects of sea-level rise. Similarly, the removal of trees and plants in Accra has destroyed natural barriers along coastlines and exacerbates coastal erosion. Since wetlands naturally expand inward with a rising sea and prevent erosion and saltwater intrusion, development in these areas prevents the wetlands from serving their natural purpose.¹⁴

Management of water resources is increasingly acute in cities both in terms of supply of water and its distribution to growing urban populations. Many countries dedicate scarce water resources to irrigating agriculture despite typically low economic returns. The dumping of untreated water combined with agricultural and industrial runoff can pollute ground and surface water resources.¹⁵ Unregulated extraction of groundwater can lead to depletion of aquifers, raising the risk of saltwater intrusion and the subsequent pollution of the groundwater. Inefficient water distribution systems and inadequate water storage capacity lead to the inefficient use of precipitation. Even though climate change scientists are reluctant to attribute specific effects of climate change to water resource availability due to natural variability in precipitation, governments are fully aware that the rapidly growing demand for water due to high population growth and economic development has the potential to exhaust scarce resources. In sum, both water management policies and quality of infrastructure have significant effects on water stress and scarcity.

Each city is uniquely exposed to a range of climate hazards and exposure to a single hazard can vary across different parts of a city. Only low-lying areas of a city may be exposed to flooding, as in Luanda where much of the city is elevated, but, in contrast, water scarcity can affect a city's entire population as seen in Casablanca. While exposure is largely determined by weather patterns that are changing due to climate change, vulnerabilities are determined both by geography and human settlement characteristics. Differing housing and infrastructure conditions can make some neighborhoods of a city more vulnerable than others. Now the discussion turns to efforts of local governments to address these vulnerabilities.

Forces Shaping the Resilience Agenda in African Cities

Among the 10 cities examined in this project, only two local governments, in Cape Town and Johannesburg, have formally adopted climate change adaptation policies (see Table 2). As of 2012, Maputo was developing a plan but it was not yet adopted or implemented. In the other seven cities, climate change adaptation has not been formally integrated into local government initiatives. But in all 10 cities, a range of local government functions, including disaster

response, water resource planning, urban infrastructure and planning, are affected directly by the three climate hazards examined here—flooding, sea-level rise, and drought—and local governments have adopted plans or policies for these functions. Therefore, local climate change adaptation policies are subdivided by (1) those that are explicitly adaptation policies (see column 3, Table 2) and (2) those that address climate change impacts even if not explicitly concerned with climate change adaptation (see column 4 in Table 2). This unanticipated categorization creates a framework for examining the introduction of the concept of climate change adaptation into local policymaking processes. This section presents the findings regarding local policymaking, but the discussion first considers national climate change policy as an important contextual factor that affects local adaptation policymaking.

Table 2
National and Local Climate Change Adaptation Plans, by City

City	National		Local Government	
	Climate Change Plans	Plans Relevant to Climate Change Hazards	Climate Change Plans	Plans and Initiatives Relevant to Climate Change Hazards
Accra	Ghana Plan of Action for Disaster Risk Reduction and Climate Change Adaptation (DRR-CCA)	Ghana Shared Growth and Development Agenda		Disaster management plan
Alexandria	National Climate Policy			
	Egypt's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction [2011]	National Strategy for Crisis/Disaster Management and Disaster Risk Reduction [2010]		
		National Law 4/1994 [Regulates such issues as integrated environmental management of coastal zones]		
		National Crisis Management Strategy		
Cape Town	National Climate Change Response Plan [2004]	National Environmental Management Act [1998]	Climate Change Strategy and Action Plan [For Western Cape]	
		National Water Act [1998]	Framework for Adaptation to Climate Change [2006]	
		Disaster Management Act [2002]	Climate Adaptation Plan of Action [2010]	Biodiversity Strategy [2003]
		National Biodiversity Act [2004]	Cape Town Energy and Climate Change Strategy [2006]	Coastal Zone Management Strategy [2005]
		National Spatial Development Perspective [2006]		Five-year Integrated Housing Plan [2009/10–2013/14]
		Comprehensive Plan for Development of Sustainable Human Settlements [2004]		Integrated Metropolitan Environmental Policy [2001]
		2010–2014 National Strategy for Sustainable Development and Action Plan		
		National Disaster Management Framework (2005)		Floodplain and River Corridor Management Policy [2009]
Casablanca	National plan against global warming	Resilient Oases Plan		Municipal Disaster Risk Management Framework [2006]
Dakar	National Adaptation Programme of Action [2006]	Plan Orsec [1999, Disaster Risk Management]		Plan Flooding in DTK Municipality
		Plan Jaxaay [2005, Flood response plan]		Dakar Urban Master Plan 2025
		Projet de Gestion des Eaux Pluviales (PROGEP) [Rainwater management program] [2011]		
Dar es Salaam	National Adaptation Programme of Action [2007]	National Strategy for Growth and the Reduction of Poverty		Dar es Salaam Transport Policy and System Development Master Plan
	National Climate Change Strategy [2012]			City Master Plan [Proposed 2010]
Johannesburg	National Climate Change Response Plan [2004]	National Environmental Management Act [1998]	Assessment to Johannesburg's Vulnerability to the Global Threat of Climate Change (2008)	City of Johannesburg Growth and Development Strategy 2040
		National Water Act [1998]	Climate Change Adaptation Plan, City of Johannesburg (2009)	City of Johannesburg: 2012/16 Integrated Development Plan
		Disaster Management Act [2002]	Gauteng Climate Change Response Strategy and Action Plan (2012)	City of Johannesburg Sustainable Human Settlements Urbanisation Plan (2012)
		National Biodiversity Act [2004]		Johannesburg Roads Agency Flood Management Plan
		National Spatial Development Perspective [2006]		City of Johannesburg Corporate Disaster Management Plan (2003)
		Comprehensive Plan for Development of Sustainable Human Settlements [2004]		
		2010–2014 National Strategy for Sustainable Development and Action Plan		
		National Disaster Management Framework (2005)		
Kampala	National Adaptation Programme of Action [2007]	National Environment Act [1995]		Kampala Physical Development Plan [Proposed December 2012]
	National Climate Change Policy Proposal	National Policy for Disaster Preparedness and Management [2010]		Environmental Management Strategy [In development]
		National Urban Policy [Proposed]		Integrated Flood Management Strategy [In development]
Luanda	National Adaptation Programme of Action [2011]	2010 Long Term Development Strategy		Master Plan
				Technical Project of green zones and drainage
Maputo	National Adaptation Programme of Action [2008]	Master Plan for the Prevention and Mitigation of Natural Disasters [2006]	Local-level climate change adaptation and mitigation initiative [In development]	Technical Project

National Adaptation Policy Context

Climate change adaptation agendas have emerged in developing countries in recent years due to concerns about potential impacts of climate change and to meet obligations under international

conventions. UN organizations, the World Bank, and other parties have actively promoted the climate change mainstreaming of national ministries.¹⁶ The adaptation agenda tends to emerge first at the national level, as is typically the case in the countries studied here. As national governments articulate climate change policy priorities to be assigned to mitigation, adaptation, and disaster risk management, a balance must be struck with other national priorities. Reflecting these priorities, national climate change adaptation policies found in eight of the nine countries studied in this project (in Morocco national policy focused primarily on mitigation, not adaptation), rarely address urban areas.

Five of the countries have adopted NAPAs under the auspices of the Least Developed Countries Fund. These NAPAs give little or no attention to adaptation in urban areas.¹⁷ For example, none of the top 15 priorities identified by Angola's NAPA address urban adaptation, and Luanda is not included among the five regions addressed by the country's NAPA vulnerability assessment. Tanzania's NAPA emphasizes the risks faced by the country's interior (water scarcity, drought, and food insecurity) but pays little attention to urban coastal areas. In Uganda, all NAPA pilot projects currently underway are located in rural areas, and none are being implemented in Kampala. The national government of Mozambique has focused its efforts on rural and agricultural adaptation and urban climate change concerns are largely ignored. National prioritization of rural climate change issues, as observed in the NAPAs, partially explains the relatively modest adaptation efforts found in the five cities in LDCs, Dakar, Dar es Salaam, Kampala, Luanda, and Maputo.

Three case study countries not subject to the NAPA requirement, Egypt, Ghana, and South Africa, have comprehensive national climate change policies and plans, some developed with support of international organizations or under obligations of international conventions. For example, the development of the Ghana Plan for Disaster Risk Reduction and Climate Change Adaptation was supported by the UNDP's African Adaptation Programme. Morocco, the fourth of the non-LDC case study countries, has a national plan that focuses on global warming, rather than adaptation, but it has yet to be implemented. In addition to their NAPAs, Tanzania adopted a national climate change policy in 2012, and Uganda has completed a policy that, as of 2013, was under review for adoption by parliament. On net, local governments in urban areas find little support for local adaptation policy in national policy frameworks.

Explaining Local Adaptation Policymaking

Despite increasing interest and attention in policy communities in Africa and elsewhere devoted to climate change adaptation, the topic rarely is formalized in policies and plans of local governments. This section discusses the factors relevant to the lack of engagement of local governments, at least in terms of formal policies and plans, in adaptation efforts.

National-Local Government Relations in Climate Change Adaptation Policy. The structure of governmental systems was found to be a primary consideration for understanding local policymaking capabilities for climate change adaptation. Tanzania's national government has significant control over urban affairs, and important resources and services critical for building resilience in cities are assigned to various national ministries, reducing Dar es Salaam's ability to act on its own. Furthermore, three municipal counties, a city council, and at least nine ministries have jurisdiction over climate change issues in Dar es Salaam and coordination among these

different bodies is both limited and inefficient. In Casablanca, as in cities elsewhere, mechanisms for collaboration with neighboring local governments are unavailable. In Dakar, the national government has been known to usurp power of local authorities, as seen in the construction of the Radisson Blu Hotel on the coastline despite the objections of city planning officials.

In addition to administrative centralization, many of these cities operate in fiscally centralized environments. In Maputo, local authorities are highly dependent on financial transfers from the central government, restricting the city's fiscal autonomy and policymaking capabilities. Dakar also operates in a fiscally centralized environment, and irregular fiscal transfers from the central government reduce operational efficiency.

Over the last two decades, many African countries have attempted to decentralize governmental systems, allowing for greater policymaking capabilities at the local level, but with limited results.¹⁸ In Morocco, for example, multiple decentralization initiatives have not produced tangible results and administrative power remains concentrated in the hands of the Wali, a regional authority appointed by the King and the Ministry of the Interior (MoI). Beyond carrying out directives from the MoI and the Wali, local authorities have a relatively limited role.

Local governments in the two cities in this study with formal adaptation policies, Cape Town and Johannesburg, have substantial capacity due in part to the relatively high level of national development as well as South Africa's relatively decentralized administrative system. Local government capacity in Cape Town enables coordination with a variety of local and international NGOs, academic institutions, and private sector stakeholders. These two cities benefit from a supportive national environment as South Africa tends to self-identify as a leader in addressing climate change challenges. Cape Town bid for the COP17 conference (that ultimately went to Durban) and has sought opportunities to engage in international climate change initiatives.

Setting Local Policy Priorities. The decision to engage in policymaking or planning for climate change adaptation by a local government is affected by that government's authority to make such decisions, resource capacity, the political context, and demands and needs of the city's residents. In the cities studied here, climate change adaptation is generally not a high priority for local governments, although most are concerned with disaster response and risk management for flooding.

The linkages between climate change adaptation and disaster risk reduction are well established and reflected at the international level in the overlapping and mutually reinforcing goals of the Hyogo Framework and the UNFCCC. National efforts in these nine countries generally acknowledge that these two policy concerns are overlapping. Among the 10 cities studied here, however, local governments tend to place a higher priority on disaster response, especially for flooding, than on adaptation. Given the frequency and devastating effects of flooding, the prioritization of response to this hazard is not surprising. More capable local governments examined in this study, through city planning and related departments, engage in flood mitigation efforts but, they do not necessarily define or frame these actions as climate change adaptation. Cities are acting primarily in a response capacity, rather than increasing adaptive capacity through long-term mitigation efforts. Furthermore, cities, at least in terms of policies and plans, often fail to recognize and address the projected impacts from more frequent or severe floods in the future.

Water scarcity, a widespread threat to urban areas in Africa, was identified as a hazard in Dar es Salaam, Casablanca, Johannesburg, Luanda, and, to a lesser extent, Cape Town. In Egypt, the Nile River meets Alexandria's current water supply needs of five million cubic meters per day. As the city's population grows (by an estimated 40 percent by 2030), both residential and industrial water consumption will grow, and water supplies may be significantly strained, a challenge also faced in the other cities. The national governments often consider drought to be primarily a rural or agricultural issue, though water scarcity can clearly have pronounced impacts on urban areas.

Responsibilities for policies addressing scarcity, water production in particular, generally fall to national governments and water resource management agencies rather than local governments; a local government at the mouth of a river has little influence on water management upstream. Across the range of governmental organizations that are potentially affected by climate change, water resource management agencies are somewhat unique in that the water scarcity hazard directly affects long-term water resource security, but this slow-onset hazard can be effectively addressed through long-term planning. Local governments may have influence over local water distribution systems and can encourage water conservation, which are important resiliency measures in their own right.

In Johannesburg, for example, water scarcity is very much a challenge but local government itself does not have the capability to implement policies needed to improve access to water. Rand Water, a parastatal, is responsible for delivering water to consumers in Johannesburg and other municipalities in Gauteng and neighboring provinces. It maintains reservoirs in Gauteng and obtains water through interbasin transfers, in particular from the two large dams of the Lesotho Highlands Water Project, through an international agreement between the government of Lesotho and the government of South Africa, represented by its Department of Water Affairs. This complex arrangement illustrates the vertical and horizontal cooperation necessary between multiple levels of government needed to address water security.

Sea-level rise, the third hazard examined in this study, does not carry a high priority for local governments in the eight coastal cities as evidenced by the lack of plans and policies addressing this hazard. Coastal erosion, marine submersion, and saltwater intrusion have been documented as significant risks in Alexandria and in Dar es Salaam, but they have yet to be addressed by the governments of those cities in any significant way. In contrast to the short-term impacts of annual flooding, sea-level rise impacts are more likely to be experienced at some uncertain time in the future. In Maputo, the UNDP estimates that the port and railway system could be at risk of seawater inundation within 20 years. Furthermore, Maputo's beaches (a popular tourist destination) are at risk of literally being washed away due to coastal erosion caused by sea-level rise. Despite these risks, government officials focus on flooding, a more immediate and visible climate change hazard. Cape Town is the only city with a plan to specifically address sea-level rise. This plan, however, has not been implemented effectively.

Local governments, generally resource-constrained, are faced with many pressing problems. Prioritizing adaptation efforts for slow-onset hazards, such as water scarcity or sea-level rise, ahead of other immediate needs in local government decision making is highly unlikely even when considering the long-term consequences. If hazards result in an immediate impact, as in

flooding, local governments are more likely to be motivated to address them, even though these actions are not necessarily framed as climate change adaptation. Independent of differences in the timing of public pressure associated with the impacts of each of the three hazards, local governments could, and should, have service delivery and planning responsibilities to help mitigate the array of impacts. But immediate pressures and concerns shape local government priorities, thus making the onset time for a hazard an important factor in explaining the level of local government engagement.

Other Actors Supporting Local Resilience Initiatives. Although climate change adaptation is rarely on the agenda of local governments, actors outside local government are developing a broad and substantial knowledge base about local climate change hazards and vulnerabilities. For example, in Kampala, researchers at Makerere University are using rainfall data to create models that will allow them to predict flooding, with the ultimate goal of developing a plan for flood management in the city. Knowledge of climate change impacts and vulnerabilities must be developed if local governments are to be able to develop effective adaptation policy, and promoting local sources of knowledge in universities or think tanks may prove helpful.

Several international organizations engage directly with local governments and influence local priorities. The World Bank and UNISDR provide assistance for vulnerability and risk assessments and UN-Habitat, UNEP, UNDP, and other agencies in technical assistance for planning. In Maputo, for example, a partnership between local government and UN-Habitat initiated the development of a local-level climate change adaptation initiative. The UNDP is active in promoting climate change issues in Accra, Alexandria, and Luanda. The World Bank is a major contributor in Dar es Salaam, Alexandria, Dakar, Maputo, Kampala, and Casablanca. In addition to funding, international organizations may provide technical expertise and human capital. In contrast, Cape Town and Johannesburg relied primarily on local and national resources for their initiatives. International networks such as the C40 Cities Climate Leadership Group and the Clinton Climate Initiative have influenced the climate agenda in Johannesburg as it strives to be a “world-class African city,” as its official branding claims. The variation among cities in the level of international support is explained by a variety of factors, among them the capacity of both local and national governments and the openness of governments to external assistance. But to be effective, international assistance needs to be framed to coincide with priorities and capabilities of local governments since a mutually shared climate change adaptation framework was not found in most cities.

This section has identified factors that help explain why resiliency initiatives are rarely conceptualized and developed at the local government level. With the exceptions of Cape Town and Johannesburg, such initiatives are frequently the product of national policy, sometimes supported by international organizations. Local policymaking for resiliency is constrained by the lack of authority and resources vested in local governments by national governments and priority setting by local governments. When a country’s governmental system is not effectively decentralized, the national government becomes key to advancing adaptation efforts. However, in the countries studied here, national priority in climate change policy is generally given to rural areas, further weakening efforts in urban areas. Moreover, local governments are found to place a priority on rapid-onset hazards such as flooding, due to the immediacy of risk and visibility of the consequences, and use their capacity and authority, albeit limited, to respond to emergencies.

Building Urban Resilience: Implementation of Adaptation Initiatives

Even though local governments were rarely found to engage in policymaking or planning for purposes of climate change adaptation, they do engage extensively in functions and activities that address both impacts of climate change, especially flooding, and vulnerabilities of local populations. These have been referred to as implementation roles, i.e. actions of local government, undertaken (1) under national plans and directives or (2) as actions under local plans that address vulnerabilities and responses to climate impacts even though not conceptualized as adaptation to climate change. In either case, local governments are performing roles of implementation of policies and plans and the factors affecting effectiveness in these roles are identified and discussed in this section.

The effects of the assignment of authority, organizational structures, and resource availability on implementation capacity of local governments are discussed first. A prominent issue in this discussion is the capacity to coordinate, both with higher-level governments and neighboring local governments. Then, two specific local government functions, urban planning and infrastructure provision, are examined given their importance in both affecting vulnerabilities and building resilience. The section concludes with a discussion of the increasingly important roles of NGOs and CBOs in implementing adaptation initiatives.

Organizational Structure and Authority of Local Governments

Local governments are embedded in national governmental systems, and the degree to which decentralization has been pursued varies among the nine countries. In addition, and independent of the degree of formal decentralization, the roles and capacity of local governments are affected by the nature of central-local government relations. Here, the effect of central-local relations on implementing adaptation initiatives and building urban resilience is addressed. Some cities, including Kampala, Accra, Dar es Salaam, Dakar, and Casablanca, are in countries that have undertaken decentralization reforms but the authority and resource availability of local governments are still restricted.

Decentralization of authority may not be comprehensive and service provision in a city may remain with national authorities, as found for disaster response in Ghana and for regional and local administration in Tanzania. In addition, local government decisions can be overruled by national authorities. Furthermore, in a decentralized system, national authorities may hold authority to appoint local administrators, thereby constraining local discretionary authority, as found in Dar es Salaam. Finally, national government may constrain local power by restricting local taxing authority and providing irregular and/or inadequate intergovernmental transfers. In sum, local governments with limited or ambiguously-defined authority and limited financial resources will be less effective in implementing resilience initiatives, as well as performing other responsibilities.

The presence of a national capital in a city provides a unique case for examining central-local government relations. Capital cities should, in principle, offer opportunities resulting from physical proximity for intensive collaboration between national and local governments. In Senegal, the national government found itself unable to implement national plans without the assistance of local authorities, including in the capital city, Dakar. Senegal's national flood

response plan, Plan Jaxaay, initially failed to include local government in its efforts to relocate and rebuild housing for flood victims. For proper implementation, the plan ultimately required local authorities to assist in determining the precise location of residences. Municipal planning was introduced at the *commune d'arrondissement* level for the first time, highlighting the importance of vertical collaboration. This example illustrates the need for centralized policymaking systems to involve local government in implementation of policies.

Decentralization in Ghana has taken the form of deconcentration where national agency staff members are placed in local government agencies. A NADMO office is present in the Accra Metropolitan Authority, thus ensuring close coordination with local government in its first responder role. NADMO has also established Disaster Volunteer Groups, whereby community members act as liaisons between the organization and vulnerable communities.

In these two cases, national-local collaboration in implementation was achieved but in distinct ways: in Dakar, the national authorities eventually recognized the importance of involving local government in implementation, while in Accra, national staff was placed in local government. These cases can be contrasted with Egypt, where the national government is deeply engaged and committed to climate change adaptation, but the highly centralized governance structure does not foster collaboration among ministries and with local governments. This leaves important cities, like Alexandria, without a strategy for action.

Municipal governments in South Africa are unique due to constitutionally defined spheres of responsibility and substantially greater autonomy and capacity than local governments in the other countries. Cape Town and Johannesburg's respective adaptation policies are being actively implemented. These metropolitan municipalities and Durban, a city that is not the subject of a case study in this project, have substantially influenced the national climate change agenda. While adaptation efforts in Johannesburg have lagged those in Cape Town and Durban, municipal governments, rather than their national counterparts, have initiated local adaptation efforts in all three.

The ability of local governments to address climate hazards has an important spatial component. Local governments face a variety of climate change hazards, and each hazard has a unique geographic scale. A mismatch between the geography of local government jurisdictions and the geographic footprint of hazards requires neighboring local governments to collaborate in order to achieve the scale required for effective action, as in the case of flooding in a river basin crossing multiple local jurisdictions. Similarly, the scale for effective action to address water scarcity must be taken beyond the jurisdictional boundary of an individual city. Thus, for some hazards, intergovernmental cooperation is essential for effective action, as is illustrated by the creation of river basin agencies in Morocco. Rather than dividing water control and management on the basis of local government administrative boundaries, new agencies were created for the water basin. This ensures that the administrative unit corresponds to the geographic scale of water management. Johannesburg is in a similar situation with respect to the previously outlined water delivery arrangement between Rand Water, the South African Department of Water Affairs, and the government of Lesotho. Johannesburg does not have its own authority to integrate climate change considerations into water planning and has very little power to implement adaptation activities beyond water conservation efforts within the city boundaries.

Another solution to the mismatch of governmental jurisdictions and hazard footprint takes the form of a higher-level government interceding to force local governments to collaborate. This can take the form of redefining jurisdictional boundaries in order to align administrative boundaries and service areas. In Cape Town, six municipalities were consolidated into a unicity, a single metropolitan-wide governmental entity. Even though this consolidation was not motivated by efficiency for climate change planning, it may well have that effect. Similarly, the formation of river basin authorities, where the scope of authority coincides with the natural river system, addresses the spatial mismatch problem.

Resource Availability

Effective and sustainable implementation of adaptation initiatives by local government is invariably tied to the availability of financial, human, and other types of resources. The level of socio-economic development in a country can be expected to affect the level of resources made available to the public sector and, consequently, its operational capacity. The level of basic infrastructure coverage in the cities and a country's level of development are related. In addition, inadequate infrastructure was found to increase vulnerability to climate related hazards, especially flooding. The level of national development, revenues available to local governments, and international funders all play roles in determining the level of resources available to local adaptation initiatives.

Cape Town and Johannesburg are among the most developed cities in the sample and their governments have more resources available, a result both of the development levels and the allocation of tax bases within the nation's governmental structure. Cape Town's local government has become as an innovator in urban environmental management and is recognized as a global leader. The city maintains diverse international partnerships and receives funding from international donors, but relies to a relatively high degree on its own resources. Like South Africa, Egypt is classified by the World Bank as an upper middle-income country, and enjoys a higher level of development than the majority of the African countries. Even though basic infrastructure coverage in Alexandria is high compared to the other cities studies, local government in Alexandria does not have access to financial resources for adaptation initiatives. Therefore, levels of national development are not, in themselves, sufficient for explaining city level engagement in implementation.

Urban Planning

Urban planning and infrastructure provision significantly impact human vulnerability to climate hazards, and ineffective planning in the past has created a legacy of conditions that exacerbate these vulnerabilities today. Several explanations for this ineffective planning can be observed in these cities. First, developers may disregard urban planning and land use regulations and build in areas that are vulnerable to climate change hazards with or without the tacit approval of local regulators. In Dar es Salaam, development has occurred often at the expense of local ecosystems and coastal preservation efforts. Second, higher governmental authorities may intercede and overrule local land use decisions. In Dakar, business development priorities of national government overruled land use regulations in the decision to construct the Radisson Blu Hotel on the coast.

Third, urban planning practices may themselves not be applied in certain geographic areas. In particular, effective land use regulation is largely absent in informal settlements, exacerbating vulnerability to some types of climate change hazards. In fact, informal settlements often develop with complete disregard to existing regulations and policies. In Dakar and Maputo, building codes are ignored and development occurs in vulnerable areas. In Kampala, there is a consensus that flooding occurs partly as a result of inadequate drainage infrastructure. In Accra, flooding is broadly perceived as a result of poor urban infrastructure and planning and not the result of increased or irregular rainfall due to climate change.

While local governments may recognize the range of issues and problems in informal settlements, they also understand informal settlement development occurs in the context of significant in-migration and the unavailability or unaffordability of housing in formal resettlements. Local governments may not feel obligated to provide services and infrastructure in these areas, justified by the very fact that informal settlements exist outside legal frameworks. But even with the growing disposition of planning communities to address issues in informal settlements, their rapid expansion creates demand for urban services and infrastructure that governments cannot meet. Furthermore, residents may not be incorporated into local political processes and, therefore, cannot use this mechanism to secure services.

Several cities have attempted to relocate informal settlement populations to less vulnerable areas of the city. The areas of resettlement, however, place residents away from the economic opportunities of the core business districts. Given the uncertain quality of infrastructure and availability of services in the areas of relocation, additional burdens fall on the newly resettled residents. Furthermore, the residents of these informal settlements are often distrustful and skeptical of government initiatives. Relocation efforts by the government, based in part on the sound assessment of vulnerabilities in existing informal settlements, have produced mixed results in Alexandria, Accra, Casablanca, Dar es Salaam, and Kampala.

While there is increasing acceptance in some cities that comprehensive urban plans must include informal settlements, the infrastructure challenges are formidable.¹⁹ The need to improve urban planning is frequently recognized by public officials and notable efforts to enhance the authority and capacity of local planning agencies are underway. For example, the local government in Cape Town approved an innovative municipal densification policy in 2012 that may provide an alternative to the relocation of informal settlements to the periphery. The policy aims to encourage more sustainable and efficient planning and land use. Recognizing that unregulated growth and inadequate policy initiatives made Luanda more vulnerable to flooding, the central government developed new agencies, including the Institute of Planning and Urban Management and Technical Cabinet of Urban Reconversion of Cazenga and Sambizanga, to create comprehensive urban master plans.

Roles of Nongovernmental Organizations

Given the slow progress of local governments in addressing the impacts of hazards, local NGOs and CBOs are becoming engaged in resilience initiatives, particularly in informal settlements. For example, in South Africa, the NGO Slum Dwellers International is partnering with local government and academia on in situ upgrading projects, including stormwater drainage to improve resilience to seasonal flooding. The presence of NGOs acting in informal settlements is

not surprising given the absence of effective local government initiatives in these areas. Informal settlements, by definition, have developed outside the institutional and legal framework of local authorities, often the lag between the development of formal housing and the extension of government services and population growth. Local authorities may view these communities as illegal and refuse to recognize a municipal responsibility to deliver services in these areas. These inadequacies generate tensions between local government and populations in the settlements but a range of cases illustrate strategies to reduce these tensions. Nongovernmental actors may provide an alternative mechanism for involving residents in informal settlements, who tend to be quite vulnerable to hazards.

In Kampala, as the local government faced resource constraints and competing priorities, NGOs have taken the initiative to develop programs that increase the resilience of vulnerable populations. In Dakar, a local NGO works directly with informal settlement residents to facilitate dialogue with the national government. In Accra, a local NGO works in informal settlements to address waste disposal, an issue central to flooding in the city due to waste buildup in drainage ditches. In some cities, the local government has identified NGOs as potential partners. An urban planning agency in Angola's local government collaborates with NGOs in conducts community outreach to implement its programs. The absence of effective networks incorporating community-based or nongovernmental organizations, as in Alexandria and Casablanca, can impede effective resilience planning and implementation.

A case that is particularly instructive of the potential role of NGOs in securing collaboration across multiple actors is seen in an urban-agricultural partnership developed in response to flooding in Dakar. A local NGO argued that flooding was less related to heavy rainfall than to the decision of city officials to end pumping water from underground aquifers due to its contamination. The organization developed a multi-sector approach in which water in urban areas is sanitized and pumped to agricultural areas, thereby lowering Dakar's underground water table and increasing capacity to absorb water during rainfall. The interaction of weather events, ecological systems, and infrastructure was complex and required an innovative solution involving collaboration among multiple actors facilitated by an NGO.

Conclusion and Application of Results

The impending impacts of climate change will pose significant challenges for public policy in African cities. Adaptation efforts must take into account a range of exposures, each with varying impacts and uncertainty around frequency of events and each affecting a different set of government functions.

Furthermore, the impact of one hazard can be affected by other hazards. For example, sedimentation derived from flooding can later affect river flows and contribute to water scarcity. Current urban development practices and behaviors found in local populations can exacerbate such vulnerabilities. Even though deleterious effects of current urban development practices are known, establishing a policy framework that accounts for the diversity of the challenges and

integrates new policy concerns into existing governmental structures and policy systems is daunting.²⁰

Climate change adaptation strategies and policies are found in Africa with increasing frequency, but local governments in the large cities in this study are yet to engage in such policies, with the important exception of the South African cities. Although many local initiatives address climate hazards, especially flooding, building urban resilience in the context of climate change is typically not a policy priority of local governments. In this section, final observations are offered on factors that seem to constrain deeper engagement and effective implementation by local governments in developing resilience measures. At the time the field research for this project concluded, March 2013, the climate change adaptation and urban resilience efforts of local governments could be characterized as incipient in most cities, with the exception of Cape Town and Johannesburg where adaptation efforts are quite substantial. Awareness of and knowledge about the need to build resilience to climate change are developing and some resources, such as technical and scientific resources and studies, required to improve these efforts are present, albeit not effectively integrated into government action.

Engaging in Climate Change Policy: Managing a Complex Agenda

Climate change is affecting both human and natural systems and translating the resulting challenges into concrete, actionable policies presents a formidable task to both national and local governments. Adaptation efforts, the focus of this study, must take into account a range of exposures, each with varying impacts and uncertainty around frequency of events and each affecting a different set of government functions. Furthermore, the impact of one hazard can be affected by other hazards; sedimentation derived from flooding can later affect river flows and contribute to water scarcity. Current urban development practices and behaviors found in local populations can actually exacerbate vulnerabilities. Even though the deleterious effects of current practice are known, establishing a policy framework that accounts for the diversity of the challenges and integrates new policy concerns into existing governmental structures and policy systems is daunting.

A climate change adaptation agenda can be assigned to a new governmental organization, such as a new ministry in the national government or a new department in the local government, thus differentiating its mission from those of other governmental organizations. In assigning the climate change agenda to a single organization, a clarity of focus in organizational mission is established. Alternatively, the adaptation agenda can be incorporated into existing governmental organizations, such as those devoted to development, infrastructure, environmental protection, energy, and disaster risk management, a process often referred to as mainstreaming. A hazard-based approach focused on a specific hazard, e.g. water scarcity, might provide a sufficiently well defined scope to facilitate collaboration among a set of governmental organizations directly affected by the hazard. But two major management issues emerge: ensuring the prioritization of adaptation in mission-driven agencies and achieving effective coordination across agencies required to address the diverse impacts of exposures and diverse sources of vulnerability.

Competing Priorities and Capacity of Local Governments

African cities, like cities elsewhere in the world, face a host of challenges. Given resource constraints, the burden on local governments to provide public services, including responding to emergencies, is challenging. Local officials understandably prioritize immediate concerns, such as public health and safety, over long-term climate change adaptation efforts. The urban planning shortfalls of local governments are understood and remedial action is being taken in many cities. Examples of progress are observed in the efforts toward densification in Cape Town, improvement in water distribution in Luanda, and flood mitigation in Dar es Salaam. But the large number of informal settlements and high population growth make it difficult to address these issues. Limited efforts by local governments to address climate change challenges result, in part, from the presence of more immediate and pressing issues on the local policy agenda.

Furthermore, climate change projections are frequently uncertain, and local governments face dilemmas in setting priorities when confronted with uncertainty around future events. Impending sea-level rise is an illustrative example. Although forecasts of the magnitude and rate of increase are imprecise, the quality of information is improving and it is fairly certain that seas will rise in coming decades. Nevertheless, at least in the coastal cities studied here, the availability of scientific information has not led to governmental action. In addition, a single local government is, on its own, simply ill-equipped and without adequate capacity to address certain hazards due to their geographic scale, a problem referred to as a mismatch between the geography of governmental jurisdictions and the footprint of a hazard. Even when substantial assets are at risk, as in the port areas facing sea-level rise, action by local governments has not been prioritized. In the one case to the contrary, the city of Cape Town formally adopted a Coastal Zone Management Strategy in 2003 and published a sea-level rise risk assessment in 2011, but the city has largely failed to act on its recommendations. In sum, political systems may deal with future uncertainty by postponing action.

Partnerships and collaboration for adaptation and urban resilience

The organizational capabilities and resources required to address the multidimensional and complex nature of climate change impacts are not found in local government alone, but are dispersed across many governmental and nongovernmental organizations and local communities. The national governments examined in this study have tended to initiate the in-country policy discussions concerning climate change. Given the relatively high degree of centralization and the need for international organizations to maximize their influence, national government leadership in climate change policy is eminently sensible. National climate change policies and plans, however, rarely include an urban component and do not recognize the unique vulnerabilities of urban areas to climate hazards, at least in the countries and cities studied here. The unique circumstances of large cities receive little consideration in national plans and the centralized public sector tends to create additional challenges for local adaptation efforts. A centralized structure offers the potential for unified and coordinated action between national and local governments, especially in instances where centralized agencies have spatially deconcentrated administrative resources, as in Tanzania and Ghana. Unfortunately, centralized structures do not, necessarily, lead to effective intergovernmental coordination. Furthermore, local governments with limited authority and capacity will not be effective, even as a partner with national

governments, in building urban resilience. South Africa, with its relatively empowered local governments, offers an enlightening contrast. With a more decentralized system, bottom-up pressure from local government officials and nongovernmental actors allows local government to influence national policy.

Given limited authority and capacity of local governments, collaboration among a range of actors seems to be a prerequisite for promoting the resilience agenda. The extensive collaboration in Maputo between international organizations and NGOs mobilizes desperately needed resources for adaptation. Given the special circumstance of informal settlements, community-based NGOs can help overcome the political and public service divide between local government and these communities. Promising avenues for collaboration are strategies that draw upon local governments as conveners or facilitators. But local governments will be more effective in developing urban resilience if amenable and able to collaborate with other actors. Strengthening local governments and creating incentives for collaboration are needed if the potential of these governments in build resilience is to be realized.

This study sought to assess the ability of the governance systems in large African cities to build resilience to climate change challenges. While local governments generally do not explicitly address climate change or have formal adaptation policies, they are building resilience through a variety of plans and actions that address climate hazards, particularly flooding. However, the plethora of competing priorities, restricted authority, and limited capacity of local governments, among other factors, prevents the effective implementation of these plans. The projected impacts of climate change combined with the unique vulnerabilities in urban areas will necessitate the building of resilience by local governments. Despite progress toward meeting the climate change challenges in Africa, the local governance systems are not being effectively empowered and utilized to build the resilience needed to protect and improve the collective well-being in cities.

Endnotes

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¹² Where not otherwise noted, findings in this Policy Research Project report are based on field interviews with more than 120 individuals in Accra, Ghana; Alexandria, Egypt; Cape Town, South Africa; Casablanca, Morocco; Dakar, Senegal; Dar es Salaam, Tanzania; Johannesburg, South Africa; Kampala, Uganda; Luanda, Angola; and Maputo, Mozambique in December 2012. The research team interviewed politicians, government officials, non-governmental and international organization representatives, academics, and civil society representatives.

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¹⁹ The experience of informal settlements in Latin America is relevant on this point. As informal, and “illegal,” settlements developed in the large cities in Latin America, local governments pursued various attempts to prevent and remove them. Over time, however, the policy focus shifted to legalization and urbanizations of informal settlements. If the likely event that this process develops in Africa, local governments will like embrace improvement in public infrastructure in informal settlements. See Janice E. Perlman, *Favela: Four Decades of Living on the Edge in Rio de Janeiro* (New York: Oxford University Press, 2010).

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Chapter 9. Climate Change, Aid, and Development

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Introduction

From 2009-2016, the Climate Change and Development Aid team within the CCAPS program has addressed three driving questions. First, how can we identify and track international aid resources that support mitigation and adaptation activities in Africa, in line with international agreements? Second, how can we use this information to assess whether or not climate aid is reaching populations and regions with the greatest vulnerability to climate change and greatest need for external resources? And third, how can we establish practical methods for financial and geographical tracking that will be useful for decision makers, within donor governments and agencies as well as government and CSO partners in developing countries?

Restated, the core objectives of the CCAPS Aid Team over the past six years has been fourfold:

- (1) Develop a clear methodology for coding and mapping subnational aid activities to provide publicly accessible, timely and comprehensive information on aid flows in Africa
- (2) Develop a useful and scalable methodology for identifying mitigation and adaptation activities within official development assistance flows to track climate resources
- (3) Modify the climate aid methodology to track and map aid for food security
- (4) Show proof of concept on all the above objectives, and network with IGOs, Governments, Think Tanks and CSOs to adopt and scale this work for sustainable impact

In the first section of this chapter, we overview the emerging debate on climate change and development, the particular risks faced by African nations and the key reasons why aid plays a crucial role in addressing Africa's responses to climate change. The second section examines the struggle to move globally from climate finance principles to

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practice, including the challenges inherent to creating transparency measures in climate aid finance. The third section overviews the CCAPS Climate Aid Tracking Program, providing details on our underlying theories and methodologies for both coding and mapping climate aid. Section four presents the findings of two major applications of this method, for all donors in the case of Malawi and for World Bank projects in all of sub-Saharan Africa. Section five concludes with reflections on the impact of this work, for policymakers, donors, and developing countries, as well as offering insights on the challenges to climate finance tracking that still remain.

Part I: Climate Change, Development and Aid in Africa

The Emerging Consensus on Climate Change and Development

Over the past decade, leading scientists and development practitioners have reached a strong consensus regarding the looming threats of climate change and the prospects for sustainable socioeconomic and human development in Africa (IPCC 2009). In short, climate change poses a disproportionate challenge especially for Africa's least developed countries, whose poor infrastructure, weak government systems, and high dependence on agriculture leave them particularly at risk. The effects of climate change are already being felt, contributing to more frequent and intense weather events, including floods, droughts, heat waves, landslides, forest and brush fires, cyclones, and dust storms. In more agrarian societies, steadily rising temperatures and significant changes in rainfall patterns are causing shifts in the onset and duration of rainy seasons, thus increasing the probability and intensity of droughts and floods.

Unstable and extreme weather creates serious risks for sustainable livelihoods and socioeconomic growth, particularly in those African countries where the majority of agricultural and livestock production is undertaken by smallholder farmers and nomadic herders. In addition to the effects on economic development, floods and droughts can also trigger or exacerbate food insecurity and heighten the spread of infectious diseases, such as cholera and dengue fever. Warming temperatures in higher altitudes can also lead to malaria outbreaks in areas once unaffected. With fast growing populations in coastal areas, climate change also poses complicated urban challenges due to rising sea levels and climate-related disasters. In some instances, rising sea levels will even pose an existential threat to small island states.

Poor and marginalized communities are especially vulnerable to the effects of climate change. They are more likely to live in places that are more susceptible to the risks of climate-related hazards, such as low-lying coastal areas and informal settlements. Lack of secure assets, property rights, and social and financial protection, including insurance, can mean that the poor, especially women, often experience greater vulnerability in the face of climate change-related disasters. For example, in Sub-Saharan Africa, women are the primary agricultural producers and account for nearly 80 percent of the household food production and nearly all child and elderly care. Yet women often lack property rights and access to credit and other services, making them particularly vulnerable to both

acute (sudden-onset or temporary) food insecurity and slow-onset climate-related issues, such as malnutrition and exposure of household members to climate-related diseases.

Poverty, development, and climate change are thus intimately linked. In the international development community, there is a concerted effort to identify and address the threats that climate change poses to sustainable socio-economic development through increased research, analysis, and direct interventions to address climate-related hazards. This is often referred to as climate-resilient development. Such development work encompasses a wide range of activities, including aid explicitly oriented around adaptation or mitigation work, such as reforestation, developing meteorological capacity and early warning systems, and climate-proofing water, agricultural, and transportation systems.

Climate Change in Sub-Saharan Africa

Sub-Saharan Africa is the region with the lowest carbon dioxide emissions in the world (0.8 metric tons per capita), yet is also the region most vulnerable to climate change. Beyond physical exposure to climate change, Sub-Saharan Africa's extreme poverty and high dependence on agriculture for food, income, and employment, increase its vulnerability to climate change. According to the 2013 World Development Indicators, the gross national income (GNI) per capita across the entire region averages around \$1,600, with large populations in many countries falling well below the absolute poverty line of \$1.25 per day. This extreme poverty is exacerbated by weaknesses in governance and social safety net systems, as well as widespread conflict, altogether undermining the ability of communities to cope with climate-related shocks and related cycles of chronic and acute food insecurity. Since 97 percent of agriculture production in Sub-Saharan Africa is rain-fed, changes in precipitation may lead to dire consequences for sustainable development and food security, especially fragile states.

Ecologically, over 40 percent of the African continent is classified as drylands, with increased desertification particularly around the Sahel. These areas are prone to water scarcity, unpredictable rainfall patterns, and persistent occurrences of drought that undermine agricultural productivity, even as demographic trends point to a booming population. In North Africa and the neighboring Middle East, the IPCC predicts that climate change will reduce rainfall by up to 30 percent by 2050, resulting in severe water scarcity and increased dependency on food imports to cope with rapid population growth. Climate change is in turn a risk multiplier in ways that directly affect the security and stability of African countries. Climate-related events are often cited as contributors to conflicts over arable land and scarce resources, such as water and livestock. Though a causal link between resource scarcity and conflict has not been proven, there is growing evidence that conflict is more prevalent in the presence of conditions that produce resource scarcity, namely areas with extremely low and high levels of precipitation (droughts and floods). Africa has also witnessed considerable forced migration as a result of climate-related events, exacerbating already dire crises of internal displacement and cross-border refugee flows.

The Role for International Aid

Many of the poorest countries in the world are highly dependent on international development aid and other forms of external financing for climate change investments. For example, in 2012 in Liberia – well before the Ebola outbreak in 2014 – aid represented 36.1 percent of gross national income (GNI). With a GNI per capita barely over \$400 and a poverty headcount at nearly 64 percent of the population, addressing climate change through extensive adaptation and mitigation programs remained well beyond the reach of the Liberian government.

The economic costs of addressing climate change in Africa will be significant. In 2009, African Development Bank President Donald Kaberuka argued that the world's advanced industrialized countries should commit \$40 billion per year in new money to help Africa address the consequences of climate change – an amount equivalent to the estimated three percent loss of gross domestic product (GDP) that will result each year due to climate change. The UNFCCC in 2010 reaffirmed that by 2030 the costs of climate change across Africa could be equivalent to 1.5 to 3 percent of GDP each year. Current estimates of adaptation costs alone in Africa range from \$40 billion annually by 2020 to \$86 billion annually by 2015. Globally, the World Bank predicts that climate change financing to developing countries will require anywhere from \$37 to 50 billion per year on top of current development aid.

The 2009 Copenhagen Accords assert that climate finance must be “new and additional” to current levels of ODA, meaning that climate aid is not supposed to crowd out or be double counted with existing aid. ODA in 2013 totaled \$135 billion, according to the OECD, of which approximately \$40 billion went to Africa. Despite differences in cost estimates of addressing climate change, there is one clear point of consensus: current international development aid flows are insufficient to meet both the traditional needs of poverty alleviation and the emerging needs driven by climate change. Development aid must be complemented by additional flows from industrialized states’ public, philanthropic and private sectors

Despite these high costs of addressing climate change, many African countries have started to pay attention to climate change issues, as evident in the growth of National Adaptation Plans of Action (NAPAs) and Nationally Appropriate Mitigation Actions (NAMAs). These national planning instruments identify sectors and regions within countries that are at the highest risk to climate change threats and recommend courses of action to reduce these risks and build resilience. Yet domestic institutional capacity and resources for climate change work are few and far between, leaving least developed countries especially dependent on international sources of climate finance.

In line with these financial needs, both organizations and states are starting to address climate change by adopting ambitious climate change strategies and attempting to mainstream climate change activities into their development programs. Under the UNFCCC, developed countries pledged \$30 billion between 2010 and 2012 through the Fast-Start Finance (FSF) program and committed to donate a “new and additional” \$100 billion per year - on top of existing levels of development finance - starting in 2020.

Although donors exceeded expectations by providing \$35 billion during the FSF period, only five to seven billion dollars went toward helping developing countries with climate change adaptation. The majority of funds instead focused on mitigation measures, such as REDD+ and Climate Investment Fund programs to prevent deforestation, improve clean energy, and increase energy efficiency. The primary recipients of these mitigation fast-start funds were middle-income countries, such as India and Brazil, which already had in place the capacity to apply for and manage complex, highly regulated international climate funds. This inadvertently left the least developed countries – those arguably the most vulnerable to climate-related shocks and in most need of such financing – with few resources to launch robust adaptation programs.

Following the initial push through the fast-start funding mechanism, climate financing has plateaued since 2012. Developed countries' commitment to increasing climate funding appears to be wavering, obfuscated by debates over who is responsible for climate aid, from which sectors such funds should come and how to measure and account for such financial flows in monitoring international commitments.

Part II: From Principles to Practice: Towards Transparency in Climate Aid

The shortfalls in new and additional funding for climate change mitigation and adaptation are compounded by the absence of a rigorous method for tracking climate funds. The challenge of tracking funding for climate change is rooted in the complexities of international aid statistics. Aid data reporting systems suffer from a myriad of problems, foremost the lack of transparency and robust information on project-level activities. The task of identifying and tracking climate-related activities within aid projects is severely hindered by the fact that, prior to the agreements on FSF in 2009, climate change adaptation and mitigation were not traditional sectors of donor reporting, and thus, are not adequately captured in existing databases.

Further, there is a great deal of uncertainty and debate regarding how climate change adaptation should be defined in the context of development: what kind of aid should “count” as adaptation (versus other types of development) and how should climate aid that has been mainstreamed into general development projects be counted? Coding schemes vary between donors and lack a common definition, which makes cross-donor comparison difficult. For example, in an April 2010 report on mainstreaming climate change adaptation into development assistance, the UNDP noted that the tools and methodologies created to integrate climate change concerns have:

...to a large extent been undertaken independently by various national and international NGOS, donors, and institutions. They have different rationales and objectives and follow numerous approaches. In addition, in the absence of a common terminology for key climate change adaptation and mainstreaming terms, the same terms are frequently used differently in the variety of mainstreaming guidance documents, tools and methodologies used to support specific components of mainstreaming.¹

Since 2004, the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) has attempted to address this dilemma by requiring bilateral donors to report on climate change activities in the Creditor Reporting System (CRS) using the “Rio Markers”, established in 1998. Under this system, donors tag their projects according to whether they target the UNFCCC provisions as “principal objectives,” target them as “significant objectives,” or are “not targeting the objectives.”²

The OECD’s use of the Rio Markers signified some progress in tracking aid for the environment. However, there are several problems with this current mechanism. First, the Rio Markers only measure mitigation efforts, while neglecting adaptation activities that are far more relevant to poor and less industrialized developing countries. In response, the OECD-DAC adopted a new Adaptation Marker (paralleling the Rio Markers) in 2010. The Adaptation Marker, however, has proved to be too poorly defined to ensure accurate donor reporting and too simple to capture the nuances in aid activities. These nuances are important for analysts and policymakers to assess whether aid is actually targeting the areas most vulnerable to climate change risks.

Second, the Creditor Reporting System of the OECD relies upon *self-reporting* of climate change activities by DAC donors, as opposed to using independent coding. Self-reporting by donors may be particularly problematic for reaching a clear idea on how much aid is devoted to climate change adaptation. Independent researchers have documented the tendency of DAC donors to over-report the number of aid projects qualifying as “principal” or “significant” for climate change under the Rio Marker system. This over-reporting is due to excessive optimism, uncertainty about how to define and code climate change activities, or perceived political pressure to appear to be devoting more resources to climate change than is actually the case.³ Arunabha Ghosh, for example, argues that the OECD DAC system “gives donors the freedom to classify projects as climate-related, thus making the system open to abuse and lacking in credibility.”⁴ Axel and Katharina Michaelowa independently reanalyzed DAC lending data and found that nearly 75% of projects given the Rio Marker did not qualify as mitigation when subjected to independent coding.⁵

Finally, the Rio Markers are only required for reporting by bilateral lenders in the CRS system and thus omit multilateral lending. As some of the largest providers of ODA, multilateral development banks (MDBs) provide a significant portion of climate financing that is not tracked in a central system. In 2011, a group of eight MDBs⁶ initiated a coordinated effort to develop their own tracking and reporting system and more closely align their individual tracking efforts. This led to the publication of *Common Principles for Climate Mitigation Finance Tracking* in 2015 and four editions of the *Joint Report on MDB Climate Finance*, with the most recent including climate financing information from 2011 to 2014.

The MDBs track and report their data at the component and or subcomponent level rather than project level and only for components that “directly contribute to (or promote)

mitigation and or adaptation.”⁷ This method limits financing for adaptation to those components or activities that offer “co-benefits,” meaning that they make an “explicit statement of intent to address climate vulnerability as part of the project.” This method allows the MDBs to distinguish between general development projects and climate adaptation programs, and more importantly, to identify, account for and financially weight climate activities within general development projects. According to this refined tracking methodology, the MDBs committed over \$28 billion to projects that address climate change in developing and emerging economies in 2014 only. Of this, 82 percent, or \$23 billion, was dedicated to mitigation and 18 percent, or \$5 billion was for adaptation. By 2015, the MDBs collectively reported US\$75 billion in climate finance between 2011-2013.⁸ Similar, although slightly less robust, reporting schemes have been adopted by bilateral donor groups outside of the OECD system, including the International Development Finance Group, which includes the Japan International Cooperation Agency (JICA) and Germany’s KfW.

The MDB Common Principals is a huge step toward standardizing a robust and rigorous tracking methodology for climate financing. However, the lack of transparency and access to raw data between the coding and reporting limits external verification. Further, the MDB methodology may also be omitting projects that provide adaptation or mitigation ‘co-benefits’ but are not explicitly motivated by climate change, and thus would not qualify under the MDBs’ methodology (in other words, it misses components that may have not targeted climate change, but nonetheless have effects that are significant). In simplest terms, contrary to Michaelowa and Michaelowa’s (2007) argument that donors tend to exaggerate the amount of their financing for climate change, the MDB reporting scheme may actually produce overly conservative estimates because it misses activities that are more “mainstreamed” into development programs. This is especially problematic for adaptation reporting. As a result, the MDB Common Principals was first released in 2015 with a sole focus on mitigation projects, and as of Summer 2016 is under revision to account for adaptation activities.

In fact, development financing has for decades contributed to improving adaptive capacity through support of activities such as promoting climate-sensitive agricultural practices, improving infrastructure, and building resource management and capacity. Adaptation activities are already well mainstreamed into traditional development assistance work on the ground and many donors have crafted robust strategies for integrating climate adaptation in their traditional development work. However, accounting in precise financial terms for the amount of resources directed towards adaptation activities remains a serious challenge. This makes it difficult for vested stakeholders to discern how well espoused international commitments to new and additional finance for adaptation are upheld in practice.

Beyond financial accountability, a second, and perhaps more daunting challenge is tracking the geography of climate aid, particularly at the subnational level. In other words, where exactly is climate aid going? Are donors directing relatively scarce adaptation funds to the sectors, regions, and populations most vulnerable to climate change? And how coordinated is climate aid?

Part III: The CCAPS Climate Aid Tracking Program

In light of these challenges and information gaps, the CCAPS Program began work in 2010 to identify and track where international development aid resources to address climate change vulnerability and build adaptive capacity have been deployed in Africa. This research provides proof of concept that it is both desirable and possible to provide accessible and timely data on climate aid to facilitate donor coordination, country adaptation planning and budget management, and stakeholder feedback and accountability.

Over the past five years, the CCAPS Program has developed and piloted a methodology to track and map activities relevant to climate change adaptation within ODA. The CCAPS climate coding methodology is driven by the desire to balance rigor with pragmatism, using the most detailed project-level information available and employing a climate-coding spectrum that captures the diversity of climate relevant activities within projects. This methodology seeks to generate activity-level information to provide a rich level of detail on where climate aid has been mobilized and also to enable comparison to the OECD's Adaptation Marker system. In this process, CCAPS hopes to empower broader analysis on the validity of prevailing international reporting practices and key insights into the best and worst practices of donor financing and reporting behavior in climate aid.

The climate coding methodology was first piloted in Malawi, where researchers climate coded and geocoded all available project documents for 27 leading development donors working in the country. This resulted in a dataset that includes 754 projects from 1996 to 2011 and approximately \$5.95 billion of committed aid. The pilot was then expanded to include all of Sub-Saharan Africa, focusing on one donor, the World Bank. Researchers climate coded and geocoded all World Bank development projects from 2008 to 2012, producing a dataset of 616 projects.

Throughout the project, the CCAPS researchers experienced two central challenges to carrying out this work. The first challenge in mapping aid is collecting robust information on aid project activities. The majority of ODA donors publish little information beyond very brief project descriptions. These short descriptions neither contain details on the specific geographical locations of various activities within a given project, nor do they provide sufficient information to assess whether a project's activities explicitly or implicitly address climate change risks and resilience.

Collecting the project information needed for geocoding and climate coding often requires direct outreach to donors in the field. While this trend is beginning to change (for example, the World Bank and the African Development Bank have begun to post all project documents on their websites), many donors are still unable or unwilling to produce and make accessible project documents, either due to a lack of capacity or bureaucratic and political resistance.

The second challenge to tracking climate aid is the lack of consensus on what counts as climate aid. Aid donors, partner countries, and climate specialists do not always agree on how to define adaptation aid, particularly within the context of development, thus complicating efforts to develop a rigorous and robust climate coding methodology. Some researchers argue that a project must explicitly include the terms *climate change* and *adaptation* to be defined as aid for adaptation. Others argue for a broader definition of adaptation aid that includes all activities that make people less vulnerable to climate shocks, based upon the notion that healthy and well-educated people are more resilient and better able to cope with the effects of climate change.

An initiate CCAPS climate coding effort on over 4,000 projects in Africa discovered that the former, narrower definition of adaptation aid defined approximately three percent of ODA as adaptation aid. However, the much broader definition of adaptation indicated that over 70 percent of ODA would be counted as adaptation aid.

The different definitions and strategies for tracking climate aid have thus led to widely varying estimates of how much climate aid exists. They have also resulted in incomparable data between agencies. This creates distinct policy problems: without data that enables coordination or concrete estimates of current funding, this definitional disagreement has in turn hindered donors' efforts to properly respond to partner countries' adaptation needs. It has prevented partner countries from effectively planning aid requests and budgets to target the climate threats within their countries. This is made particularly difficult by donors' focus on different aspects of how to adapt to climate change. The lack of consensus by the international community as to how to approach the climate-development challenge has hindered attempts to effectively support local populations in preparing for the adverse effects of climate change. At the highest levels of politics, it also poses serious challenges for monitoring and verifying international commitments to climate finance.

The CCAPS Coding Methodology

The public policy problems identified above been a key motivation in the CCAPS Aid Team's work between 2011-2016. The CCAPS work began 2011-2012, just prior to the start of the MDB working group on climate finance tracking and subsequent NGO efforts, such as the Adaptation Finance Tracking Initiative hosted by the World Resources Institute, Overseas Development Institute and the Climate Policy Initiative.⁹ The CCAPS Aid Team developed and piloted a climate coding methodology for tracking development assistance that enables analysis of both the financial and spatial aspects of climate aid – work that was shared with both the MDB and NGO working groups at nascent stages of their own adaptation tracking programs.

Specifically, the CCAPS methodology sought to capture several aspects of adaptation activities within ODA programs that would allow for assessments of the following dimensions of climate aid:

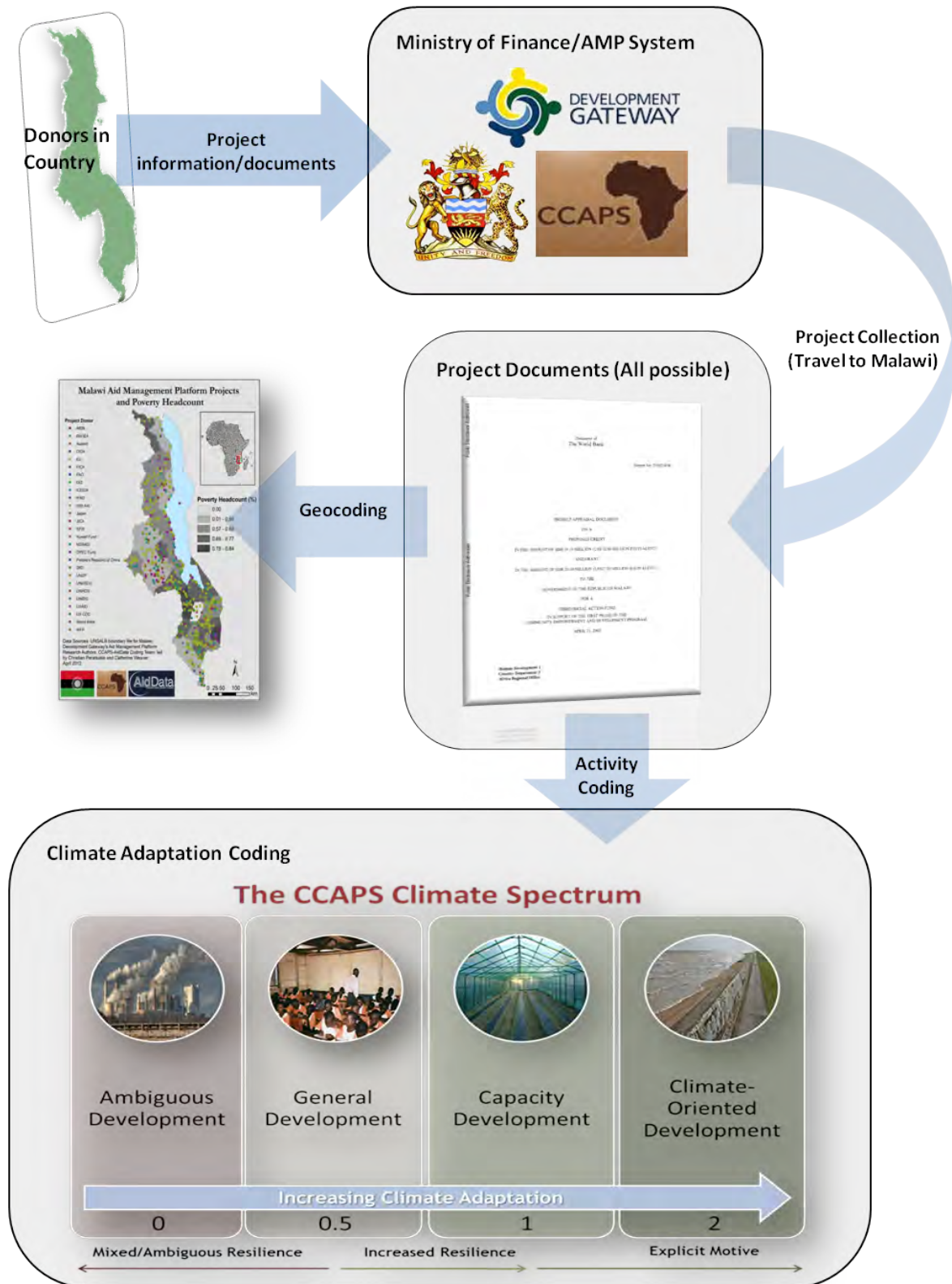
- (1) Funding: How much aid can be classified as relevant to climate change adaptation?
- (2) Sectors: Which activities are most prominent within climate aid?
- (3) Donors: Which donors are most engaged in climate change adaptation activities?
- (4) Location: Where are donors funding adaptation projects?

The CCAPS methodology relies upon a robust coding exercise using actual donor project documents. Each project document is read in full by two independent coders, who first identify all activities with the project. Each activity is then geocoded and climate coded simultaneously, with discrepancies reconciled by a senior coder (arbitrator). Thus, each project is fully vetted by three highly trained coders, with an inter-coder reliability rate of over 84 percent. The process is illustrated in Figures 1 and 2, and described in more length in a 2012 research brief published by the Robert S. Strauss Center for International Security and Law at The University of Texas at Austin (see also Appendix 1).¹⁰

Figure 1: The CCAPS Coding Methodology



Figure 2: The CCAPS Climate Coding Methodology



The CCAPS methodology codes for the climate relevance of aid activities using a continuous spectrum (see Figure 2). The spectrum includes four poles, ranging from *Ambiguous Development* (which provides the least benefit to adaptation, including maladaptation) to *Climate-Oriented Development* (which is explicitly designed to address climate issues). In between these are two categories: *Capacity Development*, which reflects activities that enhance resilience to climate change but are not explicitly carried out with that purpose in mind; and *General Development*, which reflects activities that enhance human and environmental well-being but are not explicitly driven by or obviously directly relevant to addressing climate change threats. For analytical purposes, CCAPS assigned values of 0 to 2 along the spectrum to enable comparison of results with the OECD Rio Markers, although these values can be changed to allow end users to assign weights according to their own value judgments.

The insistence on activity-level, as opposed to project-level coding, is critical in order to achieve a much richer level of detail. Activity-level coding allows for the calculation of a project score based on the individual activity components but is more time and labor intensive than project-level coding. To determine if activity-level coding adds additional information, CCAPS compared the results of activity- versus project-level coding and found that the results did justify its use.

The CCAPS method for assessing the climate relevance of development aid is thus different from current methods that rely upon short project descriptions (as opposed to full project documents) and code only at the project level. Emphasis on activity-level coding is especially critical to CCAPS's endeavor. While technically simpler, project-level coding can create the illusion that a development project has only one thrust. In reality, of course, most projects have multiple objectives, some of which may be very different from the others, and therefore have very different climate adaptation impacts.

As mentioned above, the spectrum scoring (0-2 values) intentionally builds upon – and is intended to be a corrective – to the efforts of the international community to track climate finance via the Rio and Adaptation Markers, developed and implemented by the OECD DAC.¹¹ Importantly, the Rio and Adaptation Markers are provided at the project level, meaning that the reported numbers can often obscure information on the amount and nature of distinct activities within aid programs as well as distort the estimates of the overall amount of development financing dedicated to mitigation or adaptation work.

The CCAPS methodology builds upon the Rio and Adaptation Markers in several ways:

1. *New conceptualization of climate aid.* Defining climate aid on a continuous spectrum provides added detail and accuracy.
2. *Accepted definitions.* This methodology builds upon accepted definitions of climate adaptation, adaptive capacity, and resilience to define the CCAPS climate spectrum.
3. *Third-party comparison and project evaluation.* Because this coding scheme is independent of any individual donor, it produces information that is comparable across different donors.

4. *Flexibility in pre-assigned codes.* This methodology offers the ability to enlist the knowledge of local climate experts in pre-assigning activity climate adaptation scores, according to local context.
5. *In-country use.* This methodology can be implemented at the recipient country level, and it is not reliant on donor reporting to a central database.

Part IV: Applications and Results of the CCAPS Aid Tracking System

Climate Aid in Malawi

In 2013, CCAPS researchers first piloted the climate aid tracking methodology in Malawi. This application was an effort to identify all bilateral climate change adaptation aid in a single partner country, but ended up capturing all sectors of aid and all official development aid projects in the country. The work drew from over a year of primary fieldwork in Lilongwe in 2011, where CCAPS researchers tracked down and digitized all available donor project documents. The documents were then coded for aid activities, climate activities, and activity level geographical locations. Through this effort, Malawi became the first country in the world to capture the near-universe of official development aid activities at the subnational level in a publically available, dynamic map. This groundbreaking work was captured in a subsequent policy report, *Malawi's Open Aid Map*, authored by CCAPS researchers and partnered and published by the World Bank, and featured prominently at the World Bank Annual Meetings and other international fora.¹²

This application of the CCAPS climate coding methodology evaluates 754 projects from 1996 to 2011 from 27 leading development aid donors working in Malawi. As the analysis reveals below, aid that explicitly targets adaptation makes up only a small fraction of Malawi's total aid portfolio (one to six percent). However, when aid that focuses on broader capacity development is also considered, nearly one-fifth of all official development assistance in Malawi contributes to reducing vulnerability and enhancing citizens' ability to adapt to climate change.

Malawi proved to be a suitable case study for several reasons. First, climate change adaption is of great importance to Malawi. According to its NAPA, Malawi is "highly vulnerable to the adverse impacts of climate change and extreme weather,"¹³ due to a combination of high reliance on rain-fed agriculture, poor energy access, and high levels of poverty. Second, aid continues to play a central role in Malawi's development. Official development assistance as a percentage of gross national income has ranged from roughly seven percent in 1973 to a peak of 41 percent in 1994.¹⁴ Finally, and perhaps most importantly, Malawi is a practical choice; it is a relatively small national, both in terms of population and area, with a moderately sized aid portfolio. The Ministry of Finance already uses an Aid Management Platform¹⁵ and was open to participating in this exercise. Because Malawi is both vulnerable to climate change and highly aid-dependent, understanding the role that aid plays in Malawi is a necessary first step in understanding how foreign assistance is helping to reduce vulnerability to climate change.

The resulting dataset includes 754 code-able projects from 1996 to 2011 that include over 2,900 activities, 2,500 locations, and approximately \$5.95 billion of committed aid. This dataset is the first of its kind, capturing the location and climate aid received by Malawi over the past decade. The key innovation is capturing information on activities within given projects, as opposed to previously existing methods (such as the OECD's Climate Markers) that provide only project-level data. The dataset also provides the means of constructing of robust and verifiable estimation of the amount of climate relevant work within traditional development assistance programs.

The coding exercise also allowed the CCAPS team to observe key variations between donors, in both their overall aid activities and their climate related financing. On average, the projects coded were comprised of approximately four activities. However, there is great variation between donors with respect to the size and number of activities in each project. For example, the African Development Bank has an average of nearly ten activities per project, whereas Norway has five and USAID has just under four. These figures greatly depend on the quality of documentation accessed from donors, as robust project-level information is needed in order to assign an accurate set of activities. A low number of activities may reflect a small or highly focused project, or simply insufficient information from which to discern the totality of distinct activities. The document collection and coding work thus became a critical means of assessing the quality of aid transparency in Malawi and the acute challenges in finding quality source data in broader transparency and accountability initiatives.

Overall, the results of this study reveal low levels of climate change adaptation aid in Malawi, whether measured in terms of dollars committed or number of projects and activities (see Figure 3 from brief 18 pg. 5). At best, if measured by combining both capacity development and climate-oriented projects, 27 percent of aid activities broadly target climate change, with six percent explicitly aimed at addressing climate change.

Figure 3: DEFINING CLIMATE AID

CLIMATE-ORIENTED DEVELOPMENT: An activity that intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by targeting enhanced adaptive capacity of these systems to actual or anticipated effects of climate change or responding to negative climate effects.

CAPACITY DEVELOPMENT: An activity that reduces the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by increasing the resilience of these systems to actual or anticipated effects of climate change.

GENERAL DEVELOPMENT: An activity that reduces the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by increasing the general well-being of these systems.

AMBIGUOUS DEVELOPMENT: An activity that has an indeterminate effect on the vulnerability of human or natural systems to the impacts of climate change and climate-related risks.

The health sector accounted for the largest amount of spending in Malawi, as donors focus on HIV/AIDS, infant mortality, and maternal health. For example, the Global Fund committed USD \$779 million to the health sector along – the fourth largest total amount of any donor. Figure 4 (from brief 18 pg. 6) presents the specific distribution of aid across the climate spectrum for six individual sectors. This analysis illustrates that though traditional adaptation sectors (such as agriculture or water, sanitation and irrigation) hold the majority of climate aid, still other sectors are also important contributors to increasing resilience.

Figure 4

This dataset also allows for examination of the allocation of climate aid at the sub-project level. For example, Figure 5 (from brief 18 pg. 6) identifies the most prevalent climate-relevant activities. As expected, agricultural activities dominate – as donors work to improve crop yields through education, soil improvement, and input supply – particularly in light of a general effort to enhance food security in the country.¹⁶ Water sector activities also play a brominate role in Malawi’s climate aid, both for consumption and irrigation.

Figure 5

The CCAPS methodology allows for enhanced analyses of donor programs, discerning key differences in the financial and geographical distribution of climate aid. The data analysis and resulting maps reveal great variation between donors in the overall number of projects implemented in Malawi per donor as well as in total financial amounts committed. Table 1 (brief 18 pg. 7) below summarizes these findings, showing Malawi's top donors, sorted by the number of projects. The United Nations Food and Agriculture Organization (FAO) ranks highest by number of climate-oriented and capacity development projects in Malawi, as well as by percentage of funding. Half of its activities are either capacity development or climate-oriented.

Table 1: Top Ten Donors by Number of Projects (* signify top five in column)

Donor	Number of Projects	Number of Activities	Cumulative Commitment (Current \$US)	Capacity Development (CD) Projects	Climate Oriented (CO) Projects	Percent of Cumulative Commitment (CD/CO, Current USD)	Percent of Activities (CD/CO)
USAID	134*	517*	\$783,907,152*	55	-	20.3	10.6
DfID	91*	380*	\$803,563,985*	39	24	3.7	16.6
Norway	70*	372*	\$201,568,181	73	72	27.0*	39.0*
UNDP	64*	159	\$80,589,289	24	11	11.4	22.0
FAO	49*	311*	\$25,807,768	122	35	66.3*	50.5*
JICA	47	79	\$110,289,276	15	1	22.9*	20.3
EU	46	227	\$906,167,082*	43	5	19.8	21.1
World Bank	25	139	\$660,833,216*	44	2	20.8	33.1*
AfDB	24	232*	\$402,985,378*	89	3	24.7*	39.7*
Ireland	23	69	\$17,475,455	10	15	41.1*	36.2*

In this case, it is especially important to note the different values obtained between activity and project-level data. For example, as shown in Figure 6 below (Brief 18, p.8), Norway's climate-oriented aid share nearly doubles when activities are the key level of analysis. If a project is evaluated solely based on its overall climate score, this can obscure climate-relevant activities occurring at the sub-project level.

Figure 6

However, when the data are analyzed by financial commitment, a different picture emerges (see Figure 7). (from brief 18 pg. 9). In this case, large donors (the World Bank, USAID, the African Development Bank, and the European Union, in particular) show much greater prominence than before, when analyzed by activities or projects. In contrast, the FAO, the Flemish International Cooperation Agency, and Ireland, all of which show strong climate emphasis by activity number and overall percent of projects, simply do not have the same financial resources available.

Figure 7

Because the projects in this dataset have also been geocoded, all data can be mapped, overlaid on other layers, such as indicators of climate vulnerability, and spatially analyzed. For example, Figure 8 (brief 18 p.10) displays aid locations for *vulnerability and disaster risk reduction and management* aid, overlaid on assessments of climate vulnerability constructed from the CCAPS climate vulnerability index. Also displayed are the districts highlighted as most vulnerable in Malawi's National Adaptation Program of Action. These districts lie primarily in the Southern region of the country, which is both central to the agriculture-dependent economy and prone to droughts and flooding.¹⁷ Interestingly, the majority of Malawi's *Vulnerability and Disaster Risk Management* project locations are found in or near these priority disasters, implying that these areas are indeed at risk, and have been targeted by donors in this sector. This is just one illustration of the types of questions that might be explored using geocoded aid data and other spatially disaggregated physical or socioeconomic datasets.

Figure 8

Towards Climate Finance Transparency: Mapping World Bank Climate Aid in Africa

In 2014, CCAPS researchers explored the potential of scaling up the climate coding and mapping methodologies to a larger geographical region for Africa. Given the scarcity of agency-level data at the time, the CCAPS team strategically selected the World Bank for this analysis, due to the availability of World Bank documents and because the World Bank is, by various accounts, the largest donor in the Africa region. The World Bank was also chosen because of its prominence in the international donor community, its

management of major global climate funds, and its early efforts to establish its own in-house climate finance reporting system that, to date, had received no external, independent validation.

The exercise allowed the CCAPS teams to understand whether the World Bank's rhetoric on climate change matched the reality of its lending. The World Bank recognizes climate change as a fundamental threat to sustainable development and poverty alleviation and has been a leader in aggressively integrating climate resilience into its development programs. Jim Yong Kim, the World Bank president, has said that "climate change poses one of the toughest challenges facing us today" and that it has "the potential to put prosperity out of reach of millions of people." As a result, the World Bank's leadership has identified climate resilience – sometimes known as "climate proofing" – as essential to the success of its development programs.¹⁸

The World Bank reported in 2013 that 13 percent of its International Development Association projects included benefits that addressed climate change. In the same year, the World Bank Group reported that it provided a total of \$6.5 billion in lending for projects that had mitigation benefits and \$2.9 billion for projects with adaptation benefits. Since then, the World Bank has implemented an internal climate change adaptation and mitigation monitoring system based on assigning adaptation or mitigation 'co-benefits' to funds for certain activities within its projects. However, even with aggregate numbers on climate financing, raw data from the World Bank's internal reporting systems remains inaccessible, leading to some lingering skepticism on the validity of the organizations' self-reported data.

To provide an independent validation of the Bank's data and an external assessment of the MDB climate finance tracking systems, the CCAPS team evaluated all World Bank development projects in Sub-Saharan Africa from 2008 to 2012 for their relevance to climate change adaptation and mitigation. The goal of this study was to calculate not only how much World Bank aid is oriented towards climate change activities, but also to assess whether that aid going to countries that most need it given their relative vulnerability to climate change. Much to the team's surprises given prior findings of similar validation exercises,¹⁹ the analysis revealed that not only are the World Bank's reported numbers on the climate co-benefits of its projects valid, there is robust evidence that indicates that the World Bank's tracking methodology may actually be underreporting the climate relevance of its programs. To skeptics and advocates alike, this is good news and a sign that one of the most important aid donors in the world is indeed mainstreaming climate change into its development activities and eschewing political pressures to over-report financing to conform to international norms and meet international commitments.

As with the previous application in Malawi, the study was constrained by the availability of detailed project documents drove the project selection process, indicating once again that shortcomings in aid transparency writ large will continue to be a challenge for effectively tracking and verifying climate aid spending. Of the 780 projects in Sub-Saharan Africa listed on the World Bank's website, the CCAPS team had to discard 164

projects due to insufficient project documentation available for coding. In total, 616 projects, covering all sectors, were climate coded (see Figure 9, from brief 32, p.5). The mean project commitment amount of these 616 projects is \$60.5 million and the median is \$25 million, with the smallest project commitment at \$50,000 and the largest at \$3.75 billion. On average, over the five years included in this study, the World Bank approved 123 projects each year.

Figure 9

This CCAPS dataset reveals where the World Bank is focusing climate-adaptation efforts, what type of activities constitute climate-relevant aid, and how much money is intended for these development projects. On average, each coded project was made up of between four and five activities. Figure 10 (from brief 32 pg. 5) shows a level of funding for climate-oriented projects at eight percent of the total dataset, or 52 projects. Indeed, in terms of both number of activities and project commitment amounts, the results are consistent, showing six to eight percent of funding and activities earning a climate-oriented final score. Furthermore, approximately 20 to 24 percent of funding was deemed relevant for capacity development with respect to climate change.

Figure 10

In its internal systems and project webpages, the World Bank assigns all projects both sector and theme classifications. Each project can have one or more designations in each of these categories. Each sector or theme designation is also assigned a percentage based on how much of a project it represents. Figure 11 below (from brief 32, p.6) shows an example of this information for a particular project, taken from the World Bank Projects and Operations Website.

Figure 11

When analyzed by theme, the World Bank marked just two percent of the project funding included in the CCAPS dataset as addressing climate change. Interestingly, however, according to the CCAPS climate spectrum, the World Bank allocates 32 percent to capacity development or climate-oriented projects, when those activities were coded from the rich descriptions provided in full project documents. As shown in Figure 12 (from brief 32 p. 7), the top theme among project activities coded as capacity development or climate-oriented in the dataset was *rural services and infrastructure*, followed by *infrastructure services for private sector development*. The *infrastructure services for private sector development* theme is largely comprised of support to private companies working to develop alternative or renewable energy sources to power their country or region. Examples include solar or wind farms and transformers, advanced water irrigation and treatment, and reducing dependence on (or decommissioning) coal-burning power plants.

Figure 12

The World Bank internally marked 33 of the 616 climate coded projects (approximately five percent) as including at least a partial climate change theme. Of these, 31 were also coded as either capacity development or climate-oriented by CCAPS, confirming the World Bank designation in the great majority of these projects.

In general, as previously mentioned, the CCAPS team found that the World Bank appears to *under-report* aid activities relevant to climate change adaptation. Of all funding commitments in the coded dataset, according to the World Bank's reporting, the organization allocated only about two percent to the climate change theme, compared to at least six percent according to the CCAPS coding methodology. In fact, 30 projects coded as climate oriented and 140 coded as capacity development by CCAPS were not assigned a climate change theme at all by the World Bank. For example, a project currently active in Senegal, entitled *Stormwater Management and Climate Change Adaptation*, did not include a climate change theme assignment; this was also the case with the *Cities and Climate Change* project in Mozambique. Other projects not flagged with the climate change theme by the World Bank were less obviously climate-relevant, but still arguably target enhanced adaptive capacity in the context of climate change. For example, the *Ethiopia Disaster Risk Management Country Plant Project, Phase I* was not assigned a climate change theme by the World Bank, but includes early-warning, disaster risk reduction, and contingency planning activities all set within the context of climate change in Ethiopia. This result indicates that the World Bank's internal tracking and reporting system may be based on a very conservative coding method that only takes into account the most explicit climate change adaptation and mitigation activities, rather than a broader set of development activities that may not directly address climate change but clearly have direct or indirect benefits for societies' adaptation.

To this point, Figure 13 (from brief 32 p. 8) shows the sector distribution of these non-overlapping projects. While no sector dominates this distribution, it is interesting to note that several of the top ten sectors are general categories (such as public administration, general water, and general agriculture). This finding suggests that the World Bank, in general, has differentiated between capacity building or administration projects and projects that directly relate to climate change adaptation, such as infrastructure or training. This study suggests that, at least compared to its climate change theme assignment, the World Bank may have a significantly greater portion of its funding contributing towards climate change adaptation in Sub-Saharan Africa than it reports. If other multilateral development banks and even bilateral donors follow similar practice, what we appear to know about climate finance commitments channeled through aid programs may be far less than what actually exists.

Figure 13

The coding and mapping work here also enables us to take a closer look at the *distribution* of climate aid in Africa. A region-by-region analysis of the dataset shows that Southern Africa (the most developed economy in Africa) received a slightly higher average amount of climate-oriented aid, at 11 percent. When taking capacity

development aid into account, compared to other regions in Sub-Saharan Africa, Central Africa has the highest proportion of its aid going toward climate aid: 37 percent of all funding to Central Africa went to climate-oriented or capacity development projects (see Figure 14, from brief 32 p.10). However, compared to other regions studied, Central Africa also received the lowest number of projects and lowest level of aid of any region, with only five percent each of both climate-oriented and capacity development funding allocated to the region (see Table 2, from brief 32, p.9). Furthermore, projects in Southern and Eastern Africa received, on average, higher climate scores than Western and Central Africa, meaning that individual projects in the former two regions generally included a greater focus on climate change.

Figure 14

Table 2

Region	Number of Projects	Number of Activities	Cumulative Commitment	Number of CD projects	Number of CO Projects	CO funding across regions	CD funding across regions	Average CCAPS Score
Central	65	356	2,203	16	4	2.2%	9.4%	0.70
Eastern	182	932	14,115	39	17	13.4%	40.2%	0.74
Southern	115	608	8,634	29	18	71.2%	20.2%	0.83
Western	254	1163	12,315	55	13	13.3%	30.2%	0.68
Total	616	3,059	37,267	139	52	100	100	0.73

Source: Justin Baker, Krista Rasmussen, and Catherine Weaver, Climate Coded and Geocoded Activity-Level Data from the World Bank's Sub-Saharan Africa Projects (Austin: AidData and the Robert S. Strauss Center for International Security and Law, 2014).

Notes: CD = Capacity Development, CO = Climate-Oriented Development.

The top recipients of World Bank climate finance for the region are shown in Figure 15 (from brief 32 pg. 10). There is an overlap of five countries between the top World Bank climate change theme countries and the top recipients of capacity development and climate-oriented aid as measured by CCAPS. Specifically, these are Nigeria, Ethiopia, Uganda, the Democratic Republic of the Congo, and Mozambique. South Africa is the highest recipient of aid as designated by the World Bank's climate change theme, yet it is also the country in Africa with the highest GNI and capacity to garner climate finance outside of development aid flows. These results suggest that while the World Bank climate aid overall is higher than official organizational statistics would suggest, finance is not evenly distributed across the continent nor is it clearly being allocated to areas within Sub-Saharan Africa that arguably most need that aid.

Figure 15

The CCAPS independent coding and analysis of World Bank projects in Sub-Saharan Africa offers new insights into climate finance that are important for at least three stakeholder audiences. For the World Bank itself, the CCAPS analysis provides an alternative, comprehensive picture of the World Bank's adaptation activities, as evaluated by an independent third party. The results of this study verify an overall positive trend in World Bank climate lending and add to a growing body of evidence on climate change mainstreaming at the Bank.

For other aid donors, the CCAPS analysis of World Bank climate aid could help to increase awareness of and inform the internal application of the new World Bank and MDB climate aid tracking system. This work in turn could help to increase transparency of climate finance tracking initiatives at the agency level. The dataset is intended for use in assessing the allocation and evaluation of climate financing.

Perhaps most critically, the CCAPS data and analysis allows developing country partners to see where the climate aid is in their country, discerning where such aid is meeting needs as identified by NAPAs and NAMAs. Likewise, such data, particularly when broken down spatially and into project component parts, can enable country governments and climate finance watchdog organizations to keep aid agencies, and more importantly, their donor governments, accountable for international pledges for new and additional financing.

Part IV: Conclusions

Climate change adaptation and mitigation will remain prominent in the post-2015 development agenda. The key challenge to making this agenda reality will depend upon the international community's willingness to invest in development assistance that addresses climate change vulnerability. As many advocates have argued, these investments will likely come only when the co-benefits of such aid are also recognized as central to the broader effort. These co-benefits capture not only the direct impact of aid on reducing carbon emissions and building people's capacity to deal with extreme weather events, but also the larger gains that result from focusing on society's sustainable development long-term resilience in the face of a changing global climate. Yet without adequate measures for tracking the full spectrum of climate investments, efforts and progress may go unreported and unrecognized.

The CCAPS work to date is a preliminary but highly promising step towards establishing a robust and reliable means of tracking climate finance in international development assistance. In particular, the strength of the CCAPS work is in demonstrating the viability of capturing detailed, project-level information that gives us a much richer picture of where resources are being mobilized to address climate vulnerabilities in developing

countries. Moreover, the geospatial component of this work allows for the data visualization and analytics that will enhance aid allocation decisions and budget management around adaptation efforts. Such promise is already being realized in the collective effort of the Joint Report on MDBs' Climate Financing, particularly on financial accounting. If integrated with some of the geomapping efforts of international movements, such as the international aid transparency initiative, it may be possible to enact accountability mechanisms to realize the key goals of the commitments made in Copenhagen in 2009.

Further, this type of study can help policymakers in several ways:

- *Targeting and allocation:* Combining climate aid location information with vulnerability studies can highlight places most in need of adaptation funds and increase geographic and sector coordination between donors.
- *Effectiveness:* In-depth knowledge of a country's climate aid landscape, including sector and spatial distributions, as demonstrated in Malawi, is a beginning point for climate aid effectiveness studies.
- *Transparency:* Tracking climate aid creates accountability for donors and recipient governments under various international funding commitments.

Still, key challenges remain and further research is warranted. The CCAPS methodology has proven to be a highly robust, yet intensive, means of tracking geographical and other activity-level data on climate aid. Two key constraints were revealed in the course of our work: the empirical challenge of gathering enough project-level information from which to conduct climate coding, and secondly the scarcity/dearth of financial data in aid documents to be able to reliably estimate the financial amount of aid going to the sector.

The first challenge remains as a result of the slow pace of adoption of transparency in regards to publishing project-level details, especially among bilateral donors. Key exceptions here include DFID and Sweden. Without detailed project information, it is difficult to complete the activity coding that is necessary to fulfill the tenants of the CCAPS methodology. Recent progress with international aid transparency initiatives and many agency-level efforts to publish project-level documentation reveals some light at the end of the tunnel.

The second challenge is trying to rigorously track the financial activities both at the commitment and disbursement levels. The MDB methodology achieves this goal; however, it depends on agency self-reporting of data that is not yet publically available and thus, is not replicable by independent sources. Because it only captures the MDB amounts, we are missing a large amount of international development aid that flows through bilateral or non-profit, private sector channels. The silver lining is that progress made by the MDBs is likely to spillover and to pressure bilateral agencies to adopt similar reporting standings (such as the previously mentioned efforts of the IFDG), leading to hope that in the near future we will see clear and enforceable common standards for all international aid to ensure accountability of international commitments to climate finance for development.

Appendix 1: CCAPS CLIMATE CODING METHODOLOGY STEP-BY-STEP

Step 1: Activity Coding

Development projects in the past have been characterized as a whole, without regard to the different activities that can be enveloped by a single project title. The CCAPS approach breaks down each project into its component activities. For example, an agriculture project might have soil conservation as its main objective, but could include local capacity building, farmer education, and water conservation as activities within the project.

The implementation of this method begins with project-level documents – the best available information on a project’s intended activities. Using these documents, each project is broken into its component activities, done by reading through the documents and assigning activity codes manually. To achieve this level of detail, the methodology employs the AidData platform, which has already developed and implemented a methodology for coding development projects to the activity level (consisting of more than 700 codes).²⁰

Step 2: Pre-assigned Scores

After activity coding, each of these codes is automatically placed under one of the climate spectrum poles, according to a pre-assigned list of activities. The key to this method is that every possible activity code is *pre-assigned* a score on the climate spectrum. An important aspect of this methodology is the flexibility in these pre-assignments, which can be adjusted before coding begins to reflect local adaptation priorities and expert knowledge.

Step 3: Manual Coding

After each activity has been scored automatically, a coder manually verifies the applicability of each pre-assigned code within the context of the project, using the available documents. Based upon evidence and context provided by the project documents, coders can adjust a pre-assigned score higher or lower on the spectrum (see also Figure 2). For example, if the activity code for ‘Internet’ is pre-assigned as *General Development*, but in a certain project the access to the internet is used to enable drought early-warning activities, the coder can change the score to *Climate-Oriented*. Coders can also assign an overall goal of the project. Finally a project goes through a double blind-coding process ending in arbitration of any differences in coder scoring.

Activities, as well as the project’s focus as a whole, contribute to a final score, which precisely identifies a project’s location on the climate spectrum. This detailed look allows the quantification and climate coding of both explicitly climate-relevant projects, as well as those projects that have adaptation components but are not primarily climate-focused.

Step 4: Weighting Projects

After manual coding, each project will have multiple climate scores: one for each of its activities and one overall project score. These scores are then used to calculate a final climate score using a simple weighted average, although results can be broken down and

analyzed in multiple ways. To determine the final climate score, the CCAPS methodology proposes a 70 percent weight for the overall project score, leaving a 30 percent weight for the average activity score of the project. This emphasis on the overall score for a project is because the overall score is most likely to represent the true objective of a project, whereas individual activity scores may show greater variation in climate scores.

A weighting mechanism is needed to be able to compare scores across projects, donors and time. Building upon the Rio Markers (which use a 0, 1, or 2 scale), CCAPS chose a similar scale to rate projects (see Figure 2). Placing projects back on the spectrum by final score allows clear comparison to other coded projects. Along the spectrum, CCAPS assigns each pole a score from 0 to 2 with equal distances between the categories except for *Capacity Development* and *Climate-Oriented Development*, which is a larger gap because of the explicit aims of climate-oriented development.

CCAPS uses this scale to allow for comparability with the OECD Adaptation Markers. There is one important caveat: despite the 0 to 2 values coinciding with the Adaptation Marker scores, an exact correspondence should not be made, as this spectrum is conceptually different than the Rio categories. Thus, a score of 1 on the Rio markers, which signifies that a project has a significant component for climate change adaptation, will not necessarily directly relate to a score of 1 on this spectrum. Assigning a 0 value for *Ambiguous Development* is valid given that it is not clear whether or not the activity or project will enhance adaptive capacity. *General Development* receives a score of 0.5 which is meant to capture those activities and projects that are overlooked by the Rio markers because they do not directly relate to climate change adaptation.

The final score (FS) for each project is determined by a weighted average of the overall project score (OS) and the average activity score ($\Sigma AS / nActivities$) as in the equation below:

$$FS = 0.7 * OS + 0.3 * [\Sigma AS / nActivities]$$

This simple weighting mechanism was chosen for several reasons. Given the lack of available activity-level financial data, calculating the average activity score assumes that each activity has the same scope and influence within the overall project. To overcome this assumption, coders choose an overall project score that serves as a way of recognizing where the main activities within the project fall on the climate spectrum. Therefore, a 70 percent weight is given to the overall project score and only 30 percent to the corresponding activity scores. It should be noted, however, that the weighting mechanism is flexible in that the relative weight of either the overall score or activity score can be adjusted according to the preference of the user.

¹ UNDP, 2010, p. 7; See also OECD, 2009; and GTZ, 2009 Aid Scramble Brief

² The Rio markers are based on the Rio Conventions on biodiversity, desertification, and climate change. For more information on the Rio Markers used in the OECD DAC Creditor Reporting System, please see <http://www.oecd.org/dac/environment-development/rioconventions.htm>

³ Michaelowa & Michaelowa, 2010.; Roberts & Peratsakis, 2010.; Rowling, M. (2010, March 26). Confusion reigns over climate aid as rich nations overstate projects. *Reuters AlertNet*. The OECD recognizes this problem, noting that the statistics on climate change ODA are “based on donors’ reporting of the policy objectives of each activity and does not represent an exact quantification of aid towards climate change adaptation.” OECD, 2009.

⁴ Ghosh, 2010, p. 19; Catherine Weaver and Christian Peratsakis, International Development Assistance for Climate Change Adaptation in Africa: The Aid Scramble, CCAPS Policy Brief No. 1 (Austin: Robert S. Strauss Center for International Security and Law, 2010)

⁵ Michaelowa, A., & Michaelowa, K. (2007). Climate or development: Is ODA diverted from its original purpose? *Climate Change*, 84, 5-21.

⁶ The MDBs include: the African Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank, the International Finance Corporation, and the World Bank.

⁷ 2014. Joint Report on Multilateral Development Banks’ Climate Finance.

⁸ “Developing Common Principles for Tracking Climate Finance,” 3 April 2015. Available at <http://www.worldbank.org/en/news/feature/2015/04/03/common-principles-for-tracking-climate-finance>.

⁹ Jessica Brown. 2015. What Counts: Tools to Help Define and Understand Progress Towards the \$100 Billion Climate Finance Commitment. Joint report of the Climate Policy Initiative, World Resources Institute, and Overseas Development Institute, August 2015. Available at <http://climatepolicyinitiative.org/publication/what-counts-tools-to-help-define-and-understand-progress-towards-the-100-billion-climate-finance-commitment/>.

¹⁰ The CCAPS climate and geocoding methodology is outlined in Christian Peratsakis, Justin Baker, and Catherine Weaver, Tracking Climate Adaptation Aid: Methodology (Austin: Robert S. Strauss Center for International Security and Law, 2012). Available at <https://www.strausscenter.org/research-briefs?download=118:tracking-climate-adaptation-aid-methodology&start=60>

¹¹ The Rio Marker system, established in 1998, requires aid donors to report on the relevance of aid projects for climate change mitigation on a scale of 0 to 2. The Adaptation Marker similarly reports on a 0 to 2 scale.

¹² Catherine Weaver, Steve Davenport, Michael G. Findley, Joshua Powell, Justin Baker and Christian Peratsakis. 2014. *Malawi’s Open Aid Map*. Policy report. Washington, DC: World Bank.

¹³ Environmental Affairs Department of the Ministry of Mines, Natural Resources and Environment, “Malawi’s National Adaptation Programme of Action (NAPA),” First Edition, March 2006.

¹⁴ World Bank. 2015. “World Development Indicators”

¹⁵ For more information on Malawi’s AMP, see Development Gateway, “AMP Malawi”

¹⁶ See New Alliance for Security and Nutrition, “Country Cooperation Framework to Support the New Alliance for Food security and Nutrition in Malawi, June 2013.

¹⁷ Environmental Affairs Department of the Ministry of Mines, Natural Resources and Environment, “Malawi’s National Adaptation Programme of action (NAPA).”

¹⁸ See, e.g., World Bank Group Climate Change Action Plan, 19 March 2016. Available at <http://pubdocs.worldbank.org/pubdocs/publicdoc/2016/4/677331460056382875/WBG-Climate-Change-Action-Plan-public-version.pdf>

¹⁹ Michaelowa and Michaelowa 2011.

²⁰ AidData’s methodology is available at www.aiddata.org/user-guide

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CLIMATE CHANGE
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Briefing for U.S. Department of Defense

CCAPS Research Team

Washington, DC

June 23, 2016



Funded by DoD's Minerva Initiative, CCAPS is a collaborative research effort assessing the security implications of climate change in Africa, and national and international capacity to respond



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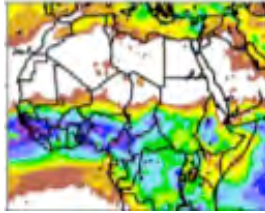
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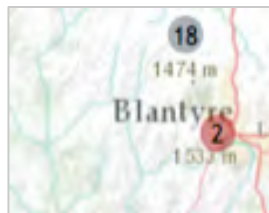
Climate security vulnerability



Climate and conflict



Government capacity to
mitigate climate stress



International aid for
climate change adaptation

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CLIMATE CHANGE
AND AFRICAN
POLITICAL STABILITY

Climate Security Vulnerability in Africa

Josh Busby

Associate Professor, LBJ School of Public Affairs
University of Texas at Austin

CCAPS Briefing
Washington, DC
June 23, 2016



Questions

- What places in Africa are most likely affected by climate security vulnerability?
- Where do U.S. strategic interests intersect with climate security vulnerability in Africa?
- Do projections of future climate change show similar patterns of vulnerability?

Agenda

- Climate Security Vulnerability Model 3.0
- Strategic Overlays
- Projections of Future Climate Vulnerability



Vulnerability

- Where are the most vulnerable locations to the security consequences of climate change?



2011 Somalia famine
250,000+ dead



2016 Ethiopia drought
18 million needing food aid



2015-2016 Southern Africa
Food shortages/agriculture/
electricity

Climate Security Vulnerability Model (CSVM 3.0)

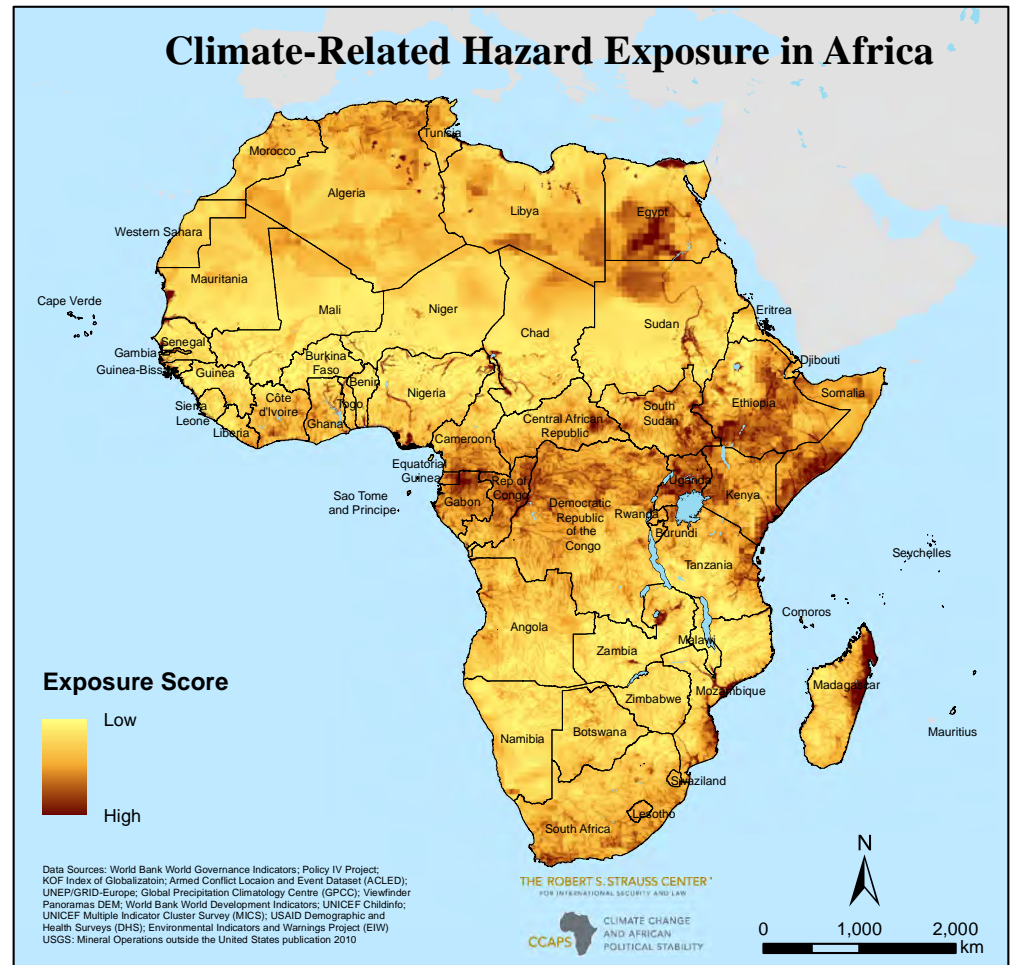
- Where large numbers of people at risk of death from exposure to climate related hazards
- Chronic
- Relative to rest of Africa
- Security

- Climate Related Hazard Exposure
- Population Density
- Household and Community Resilience
- Governance



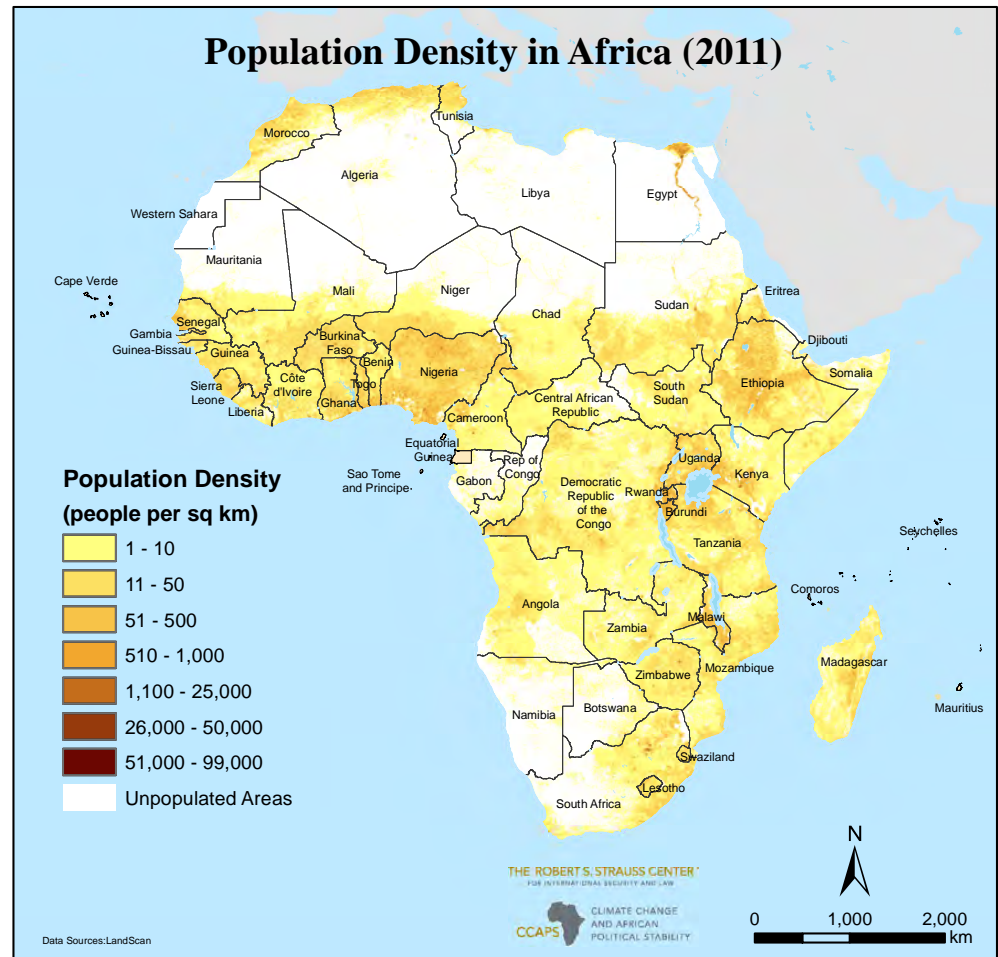
Physical Exposure

- Cyclones
- Low elevation coastal zones
- Wildfires
- Floods
- Water anomalies
 - Chronic water scarcity
 - Negative rainfall deviations



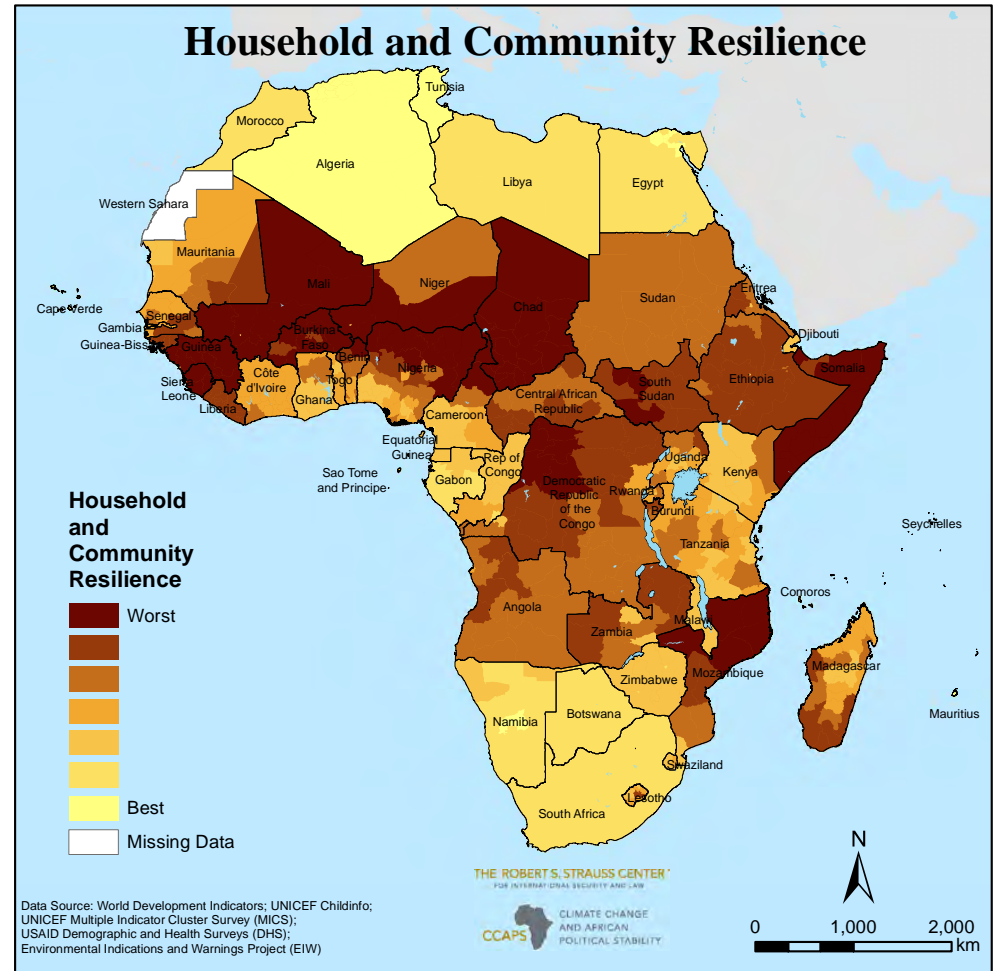
Population Density

- LandScan



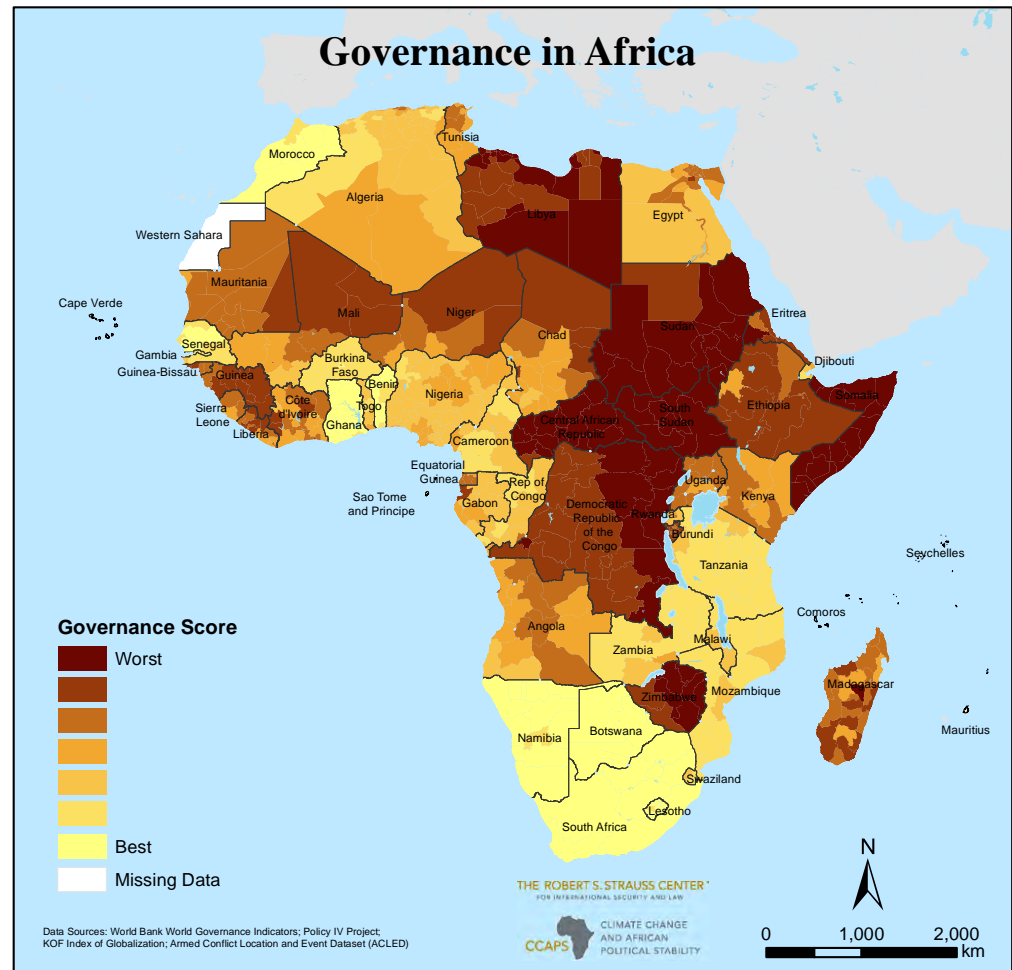
Household and Community Resilience

- Net school enrollment*
- Literacy rate *
- Access to improved water sources*
- Percent children underweight*
- Infant mortality*
- Life expectancy
- Health expenditure per capita
- Delivery in a health facility*



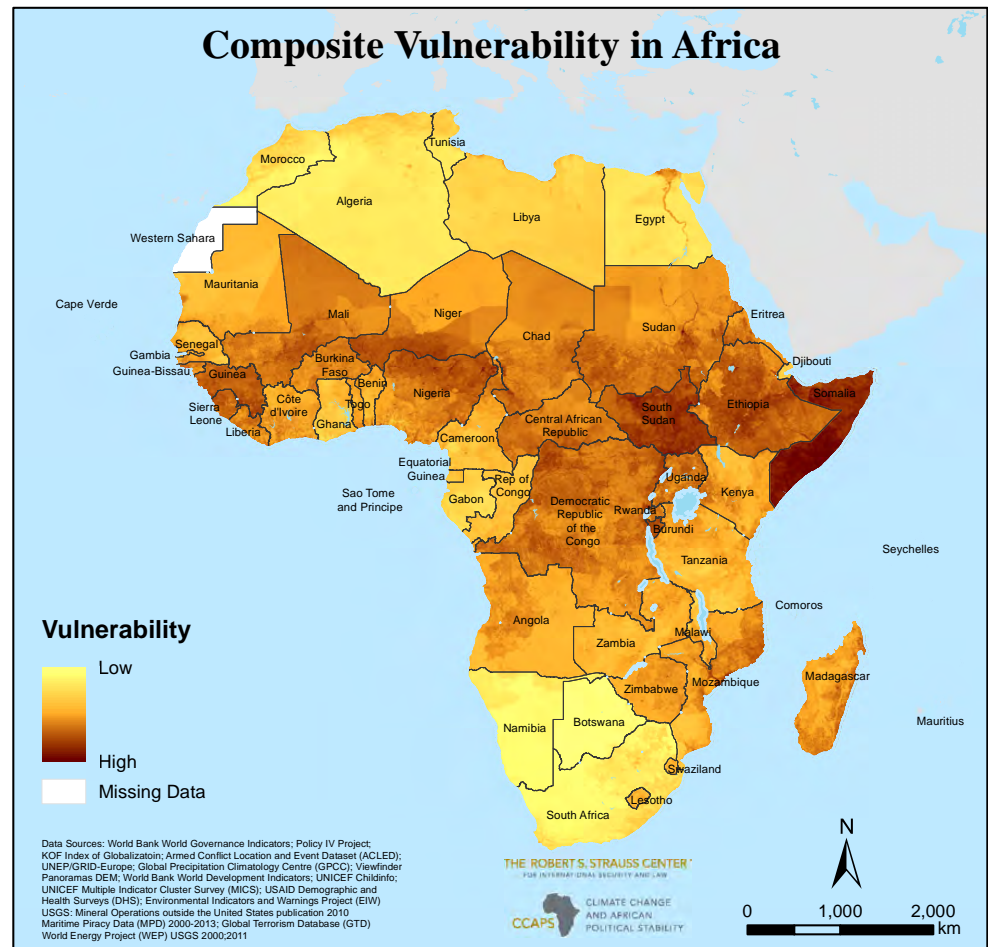
Governance

- Government Response Capacity
- Government Responsiveness
- Political Stability
- Openness to External Assistance
- History of Violence*



Composite

- Additive
- Equally weighted
- Dashboard
- <http://ccaps.developmentgateway.org/>

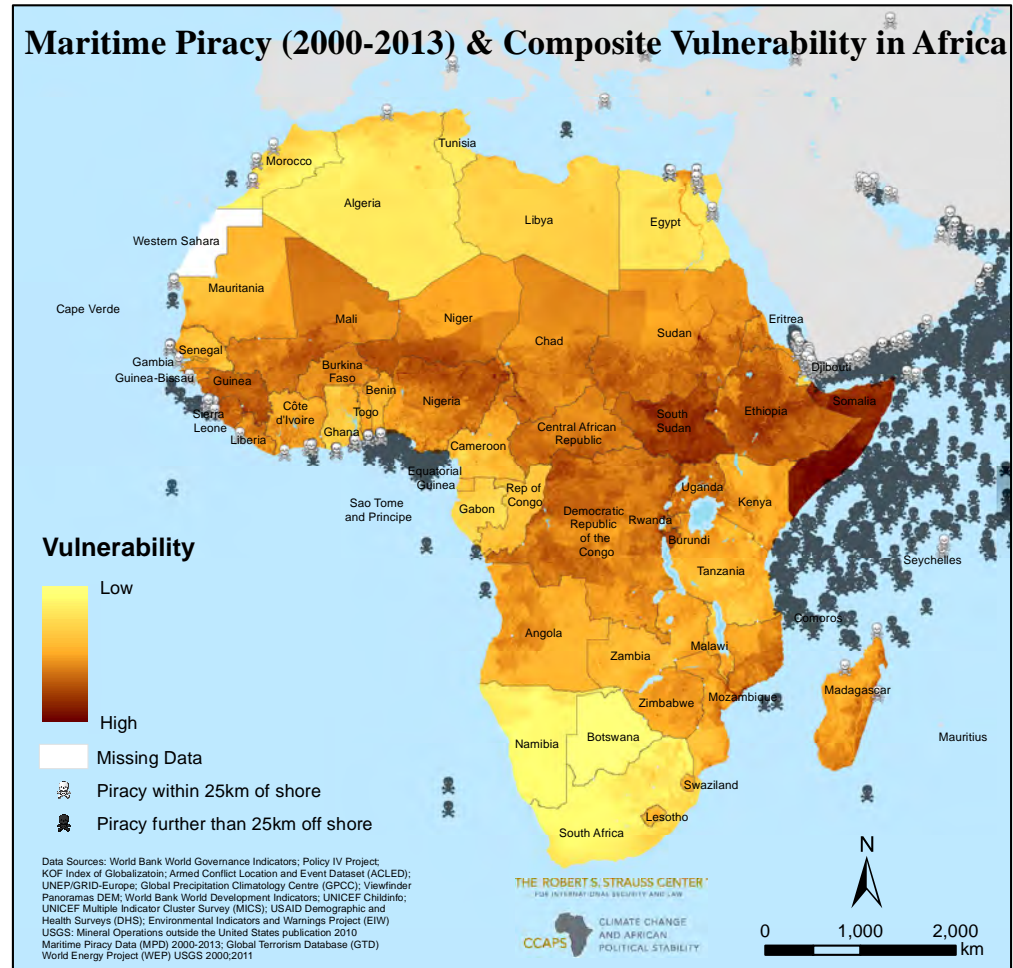


Strategic Importance

- Overlays of Strategic Importance and Vulnerability
- Piracy
- Terrorism
- Sources of Raw Materials
 - Oil
 - Minerals

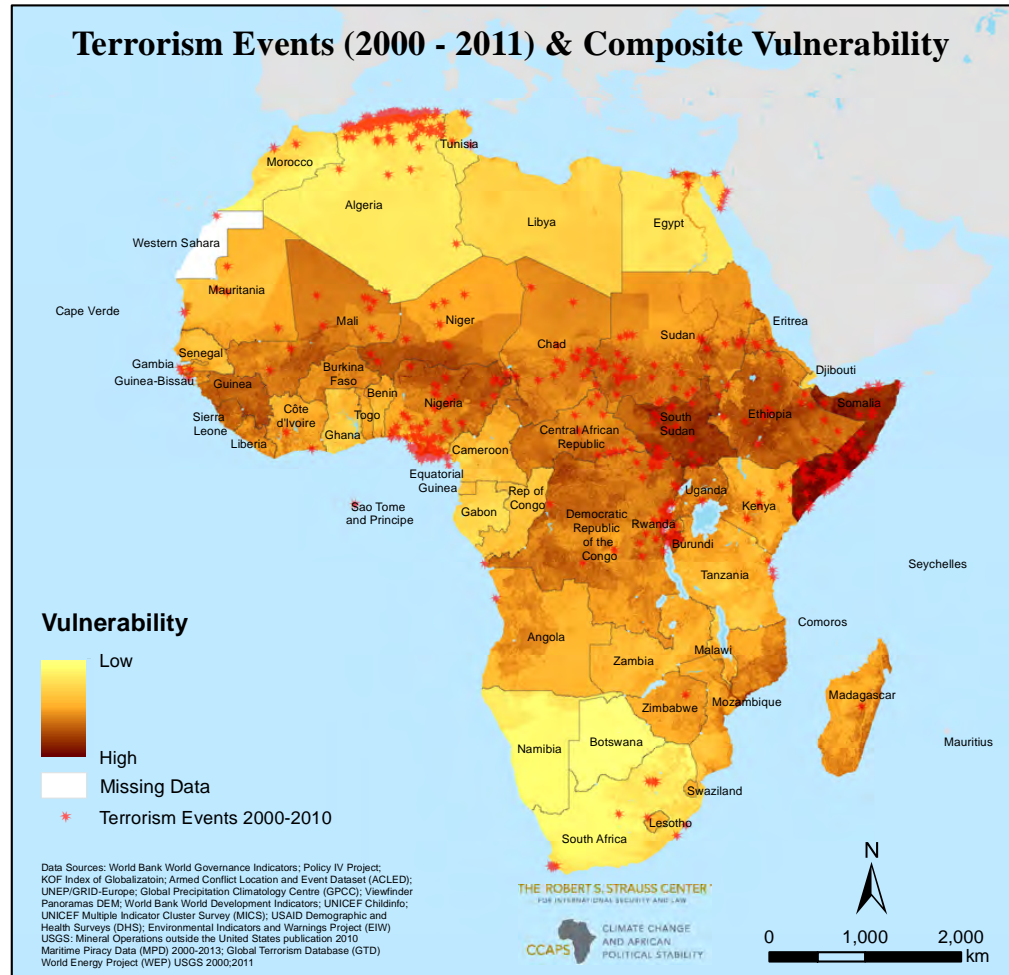
Piracy

- Somalia – Gulf of Aden
- Nigeria – Gulf of Guinea



Terrorism

- Somalia
- Nigeria
- South Sudan
- Potential Double Counting



Oil

- South Sudan
- West Africa



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Minerals

- No rare earths
- West Africa



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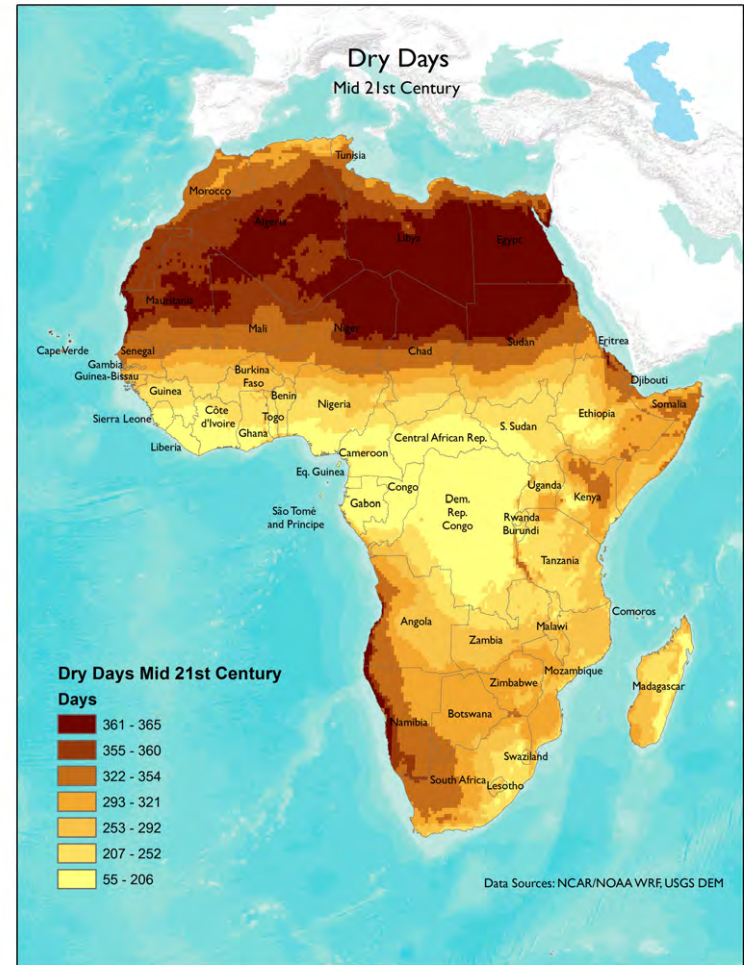
2050 Projections of Climate Change

- Dry Days
- Heat Wave Events
- Extreme Precipitation
- Regional climate model – Kerry Cook and Ned Vizzy, U. of Texas

Dry Days

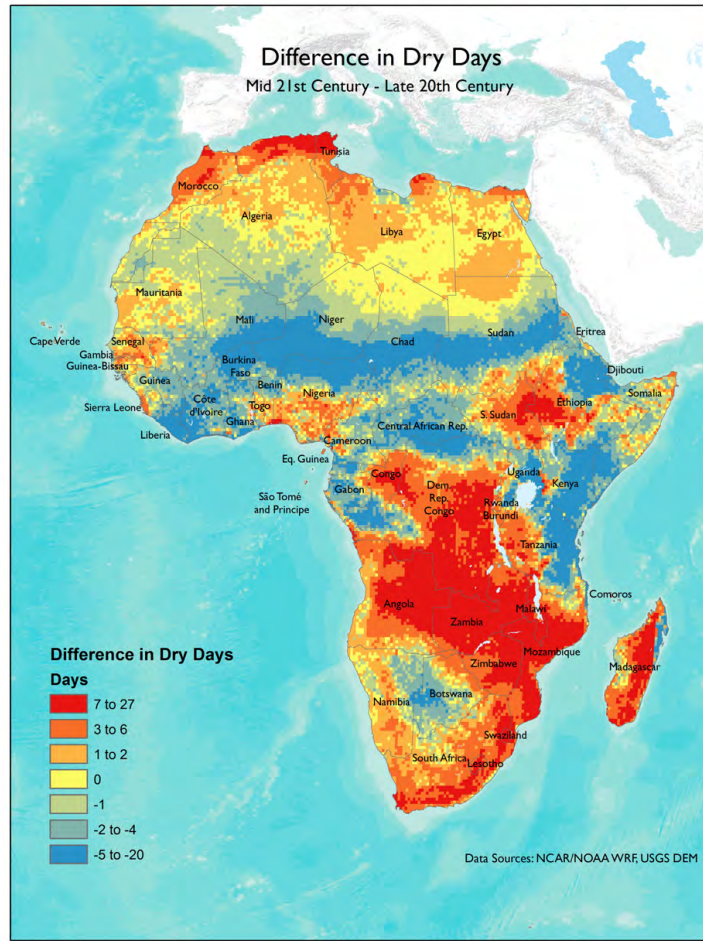


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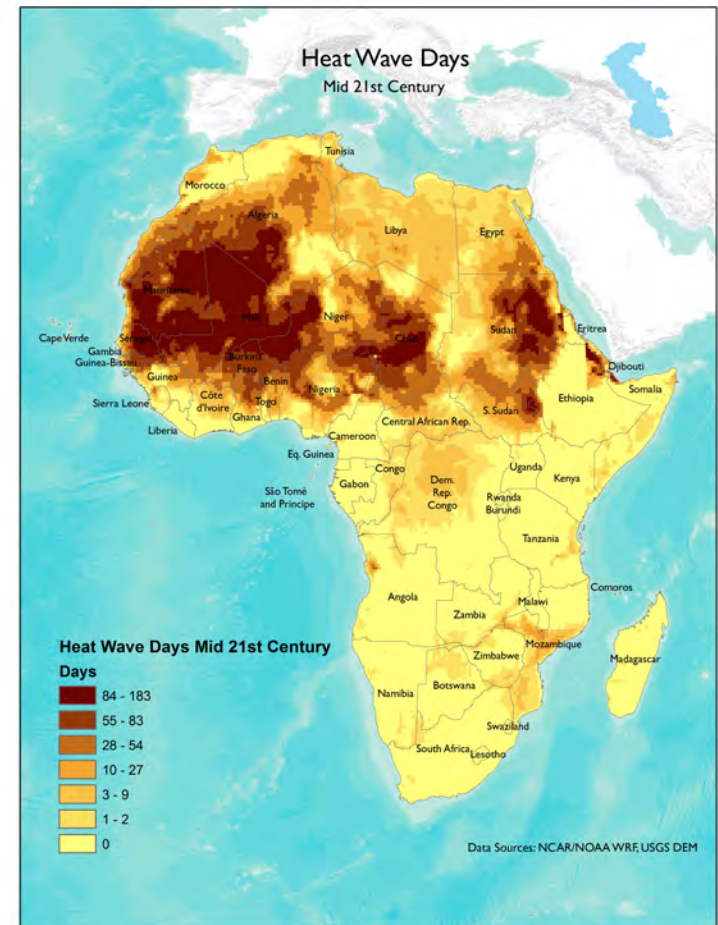
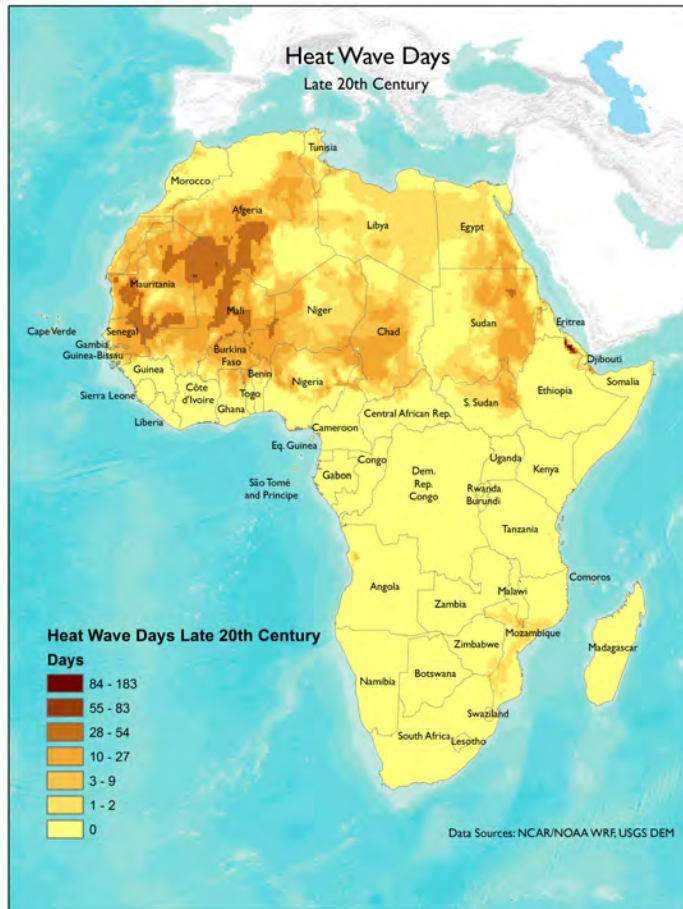


Sahel wetter

Dry Days Difference Map

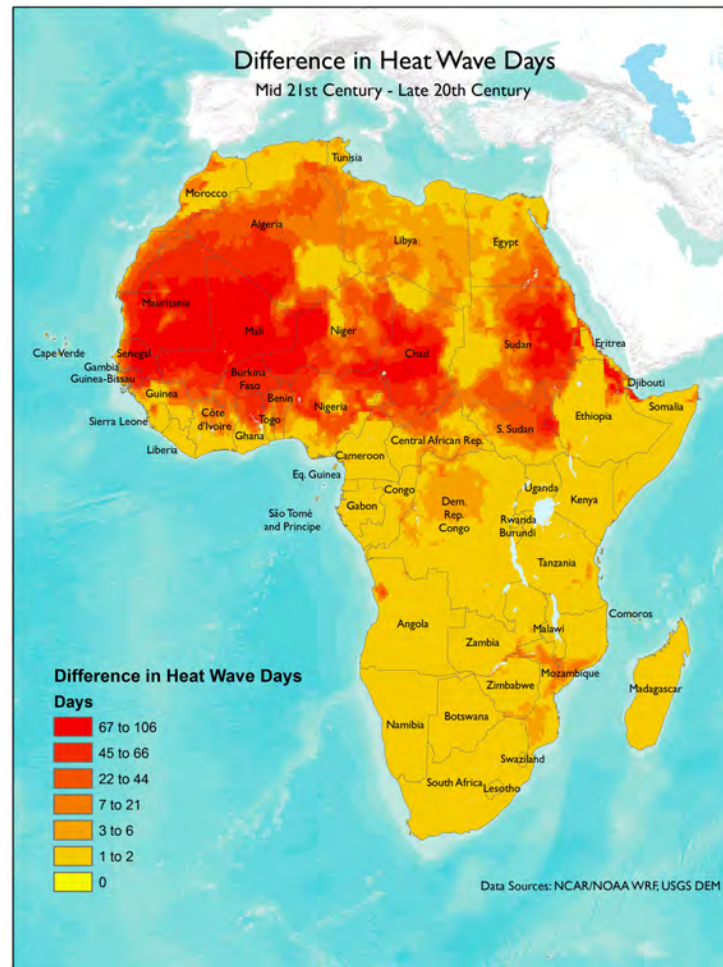


Heat Wave Days

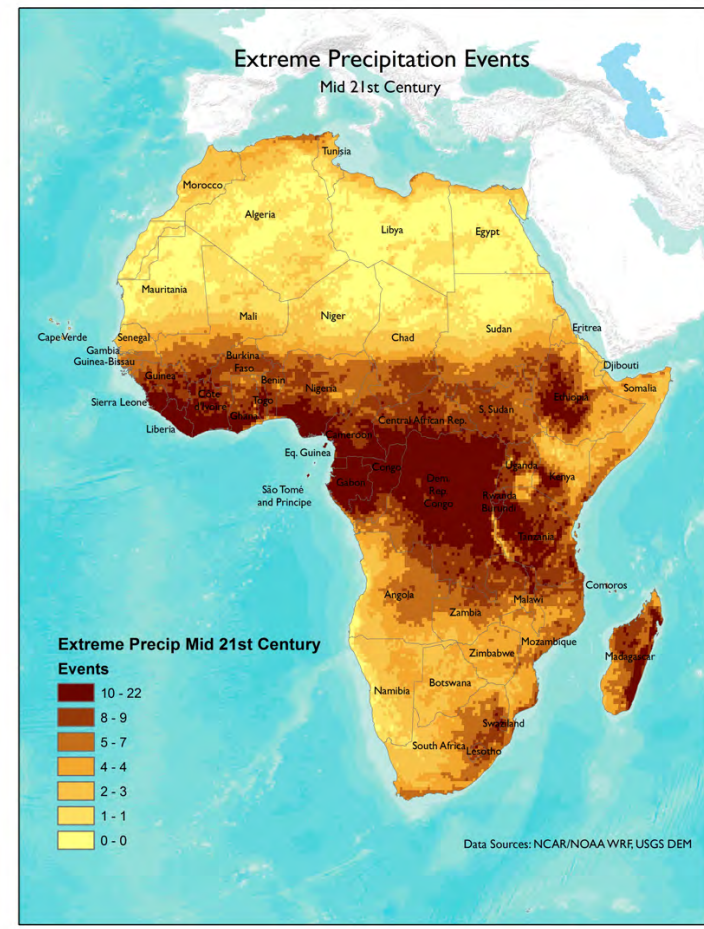
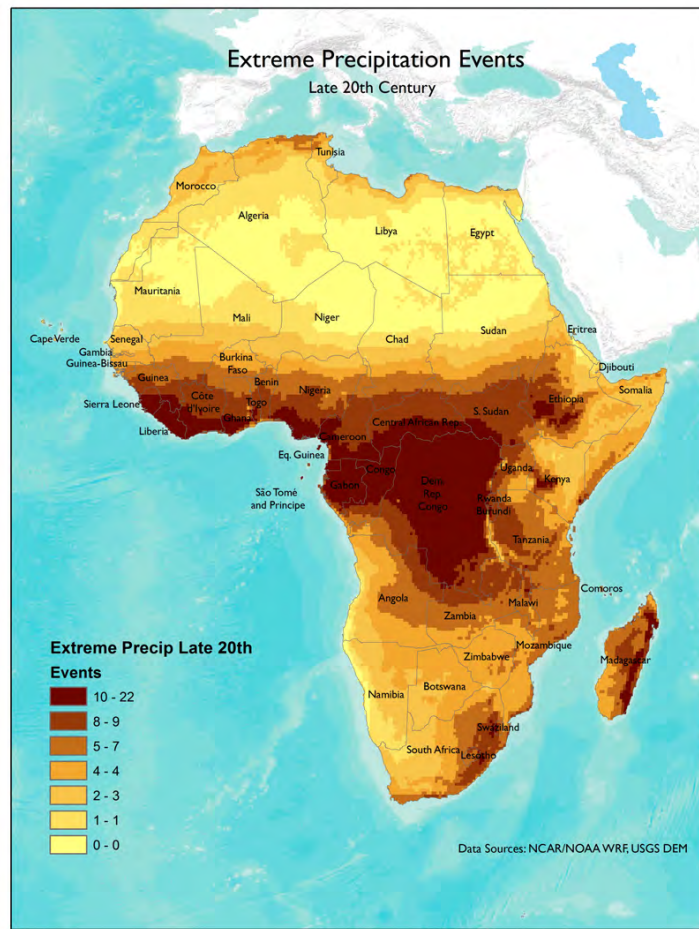


but West Africa, Sahel hotter

Heat Waves Difference Map

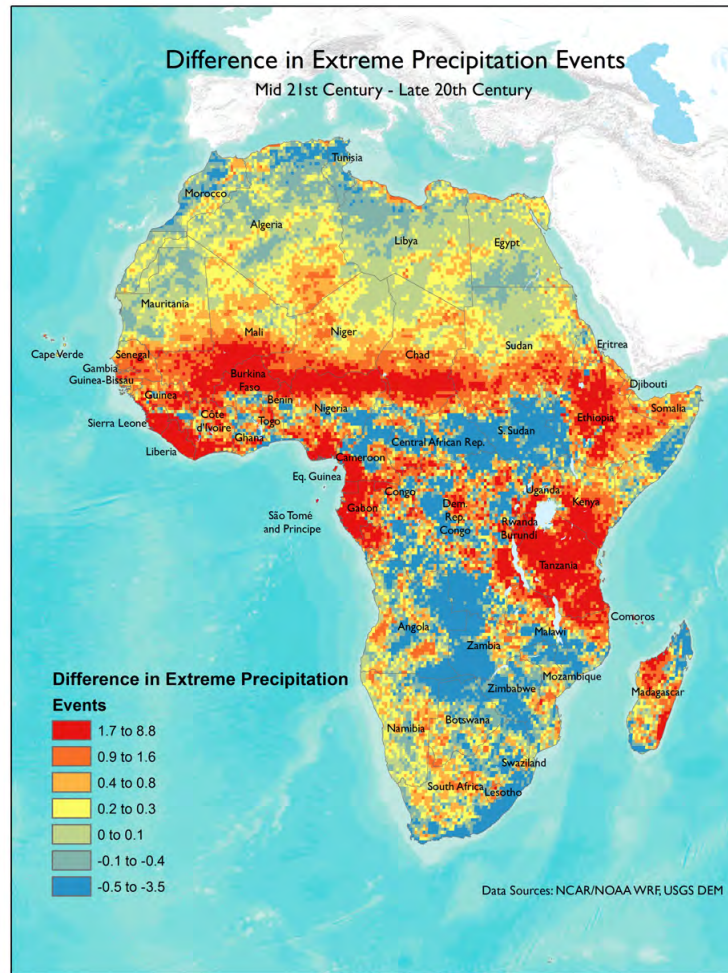


Extreme Precipitation Days



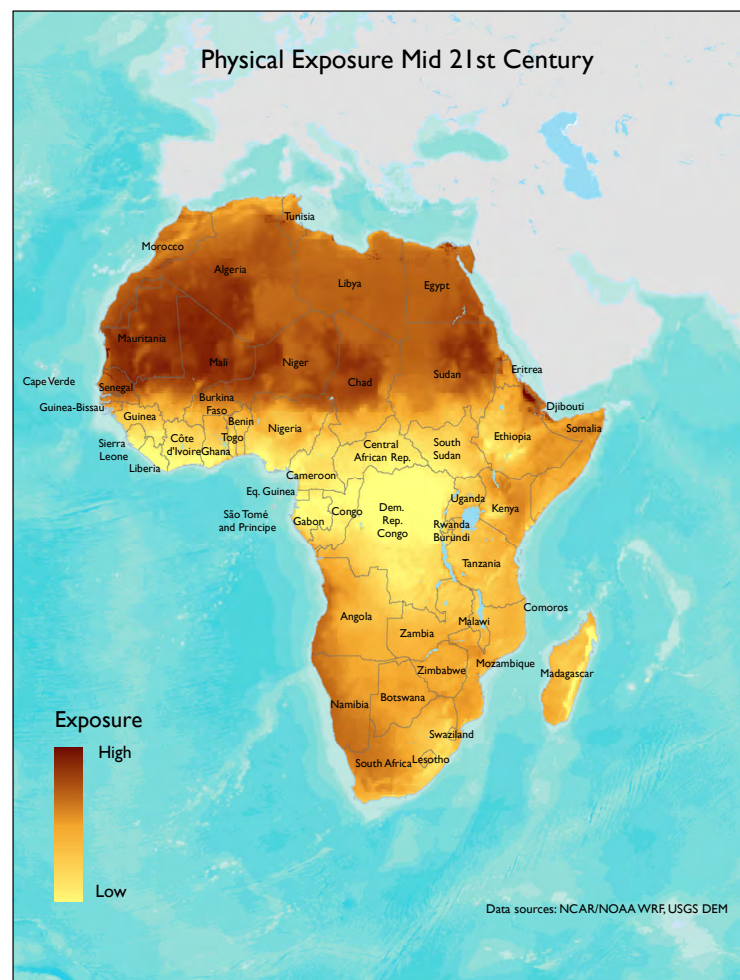
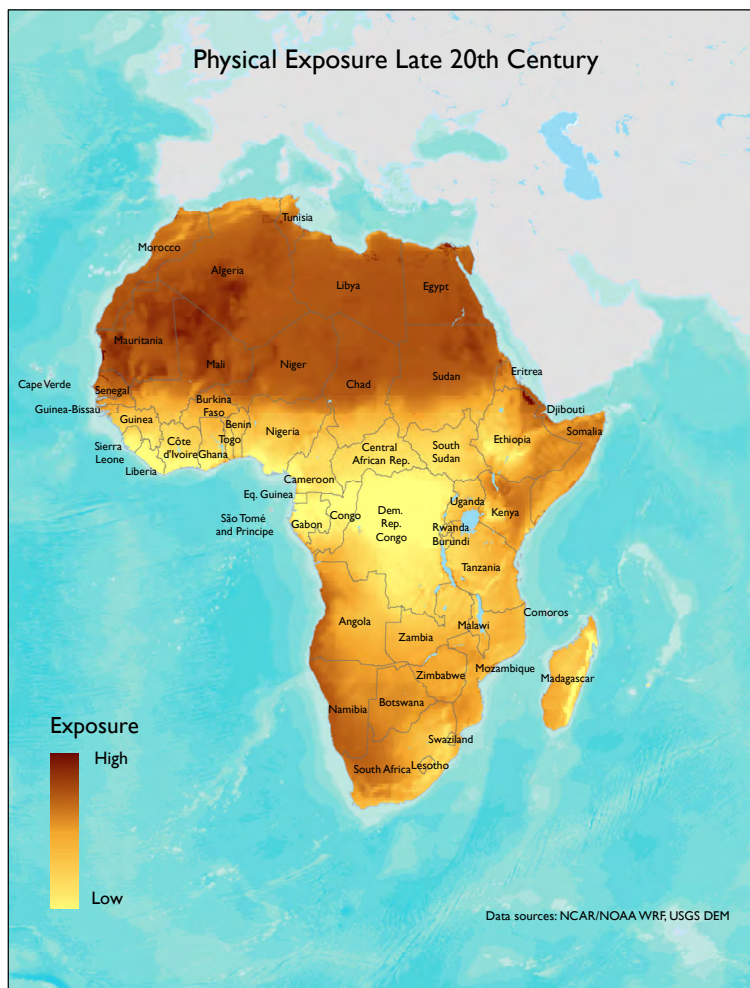
More extreme rainfall Ethiopia, Tanzania, Nigeria

Extreme Precipitation Difference Map

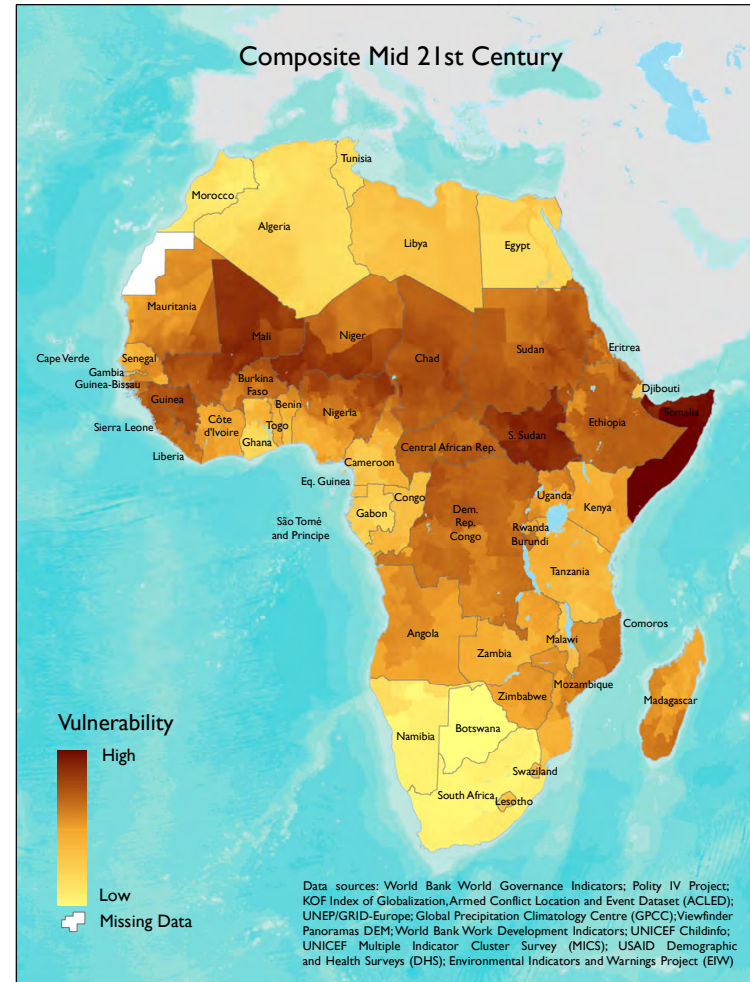
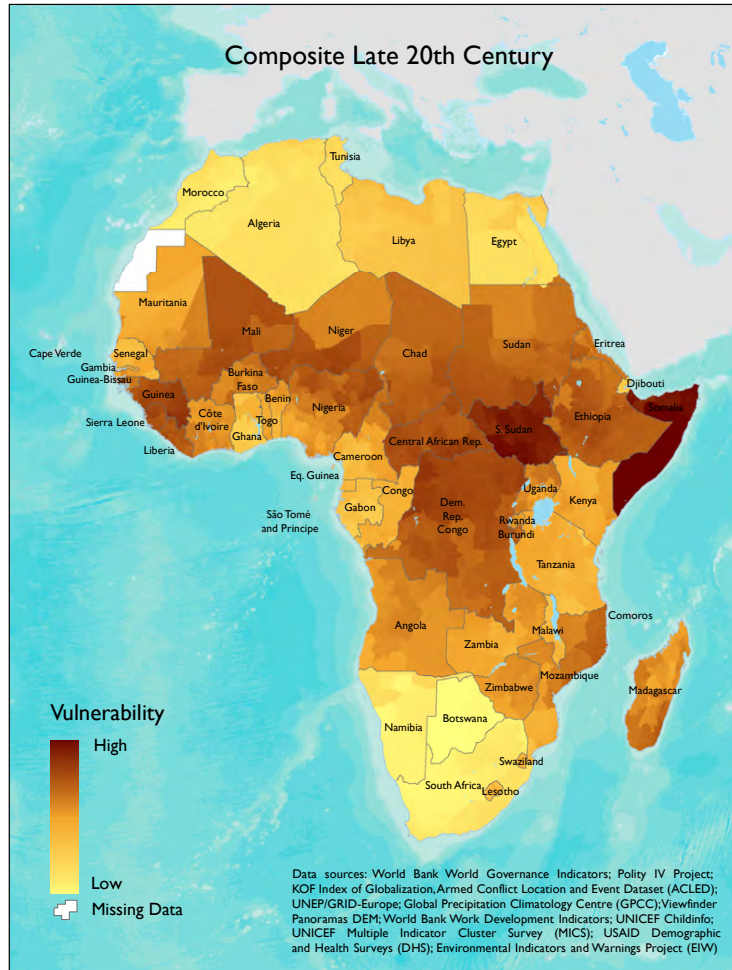


More extreme rainfall Ethiopia, Tanzania, Nigeria

Physical Exposure

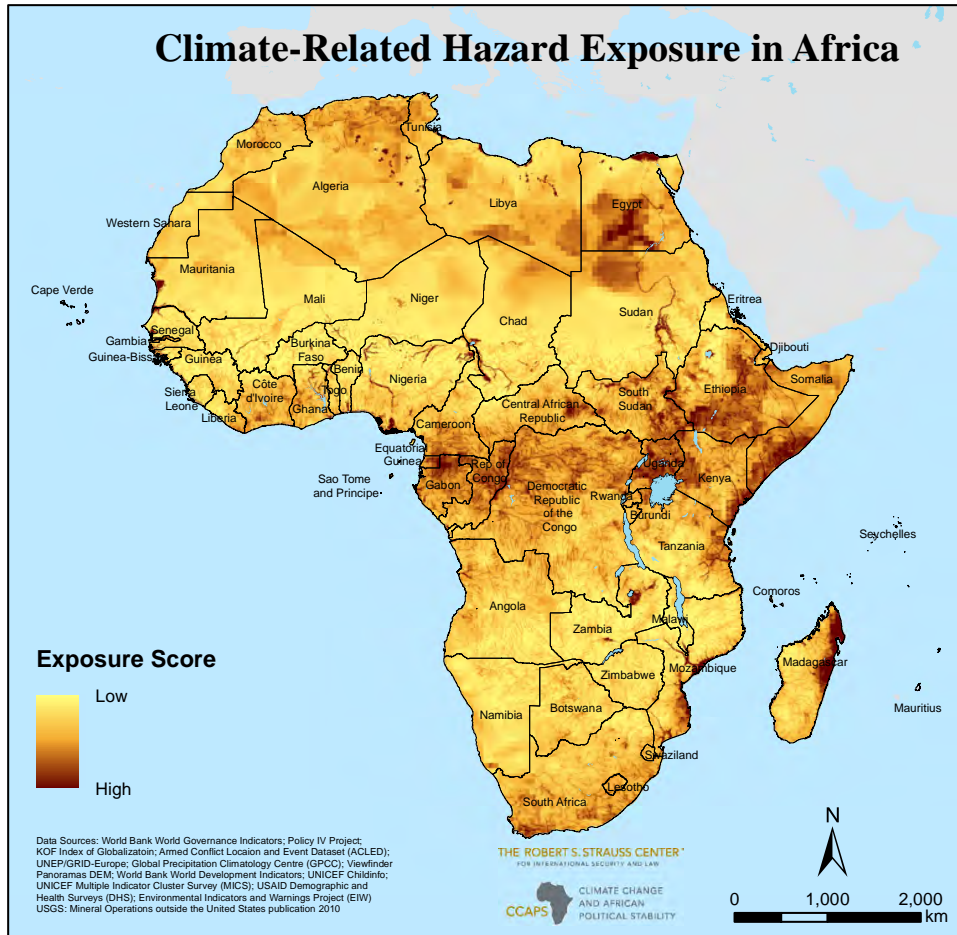


Composite Vulnerability

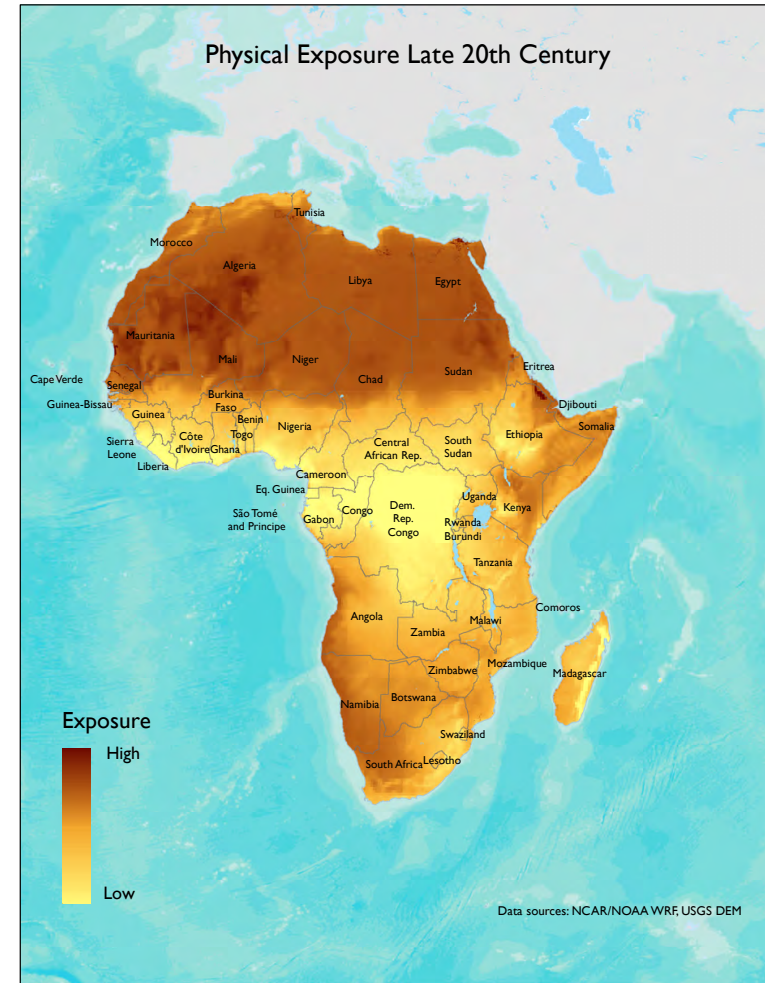


Comparison of Physical Exposure

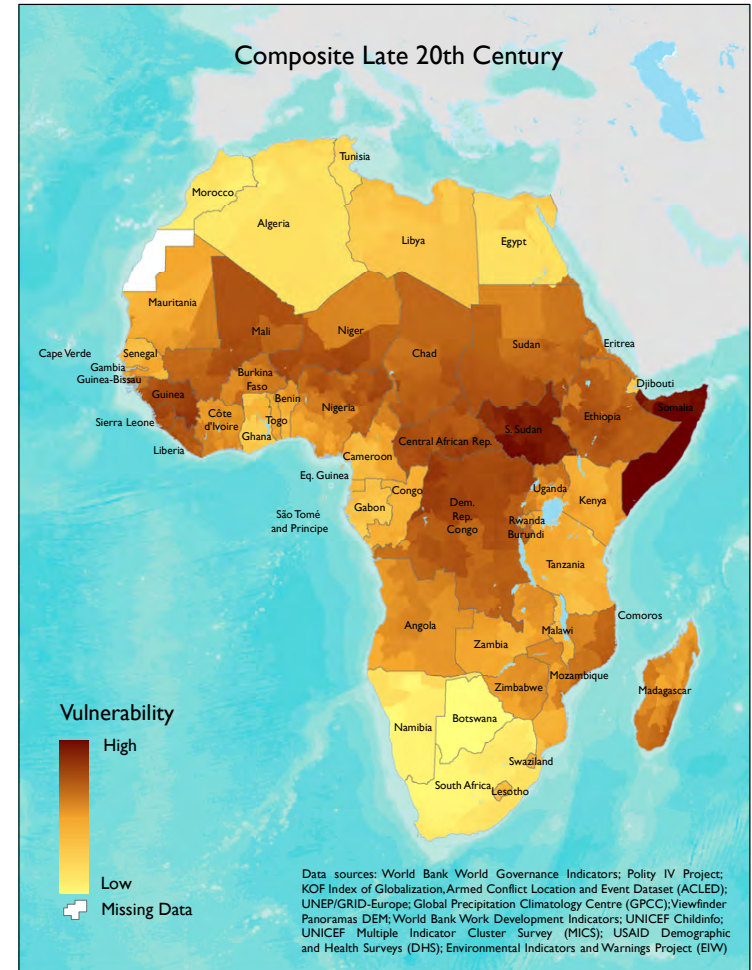
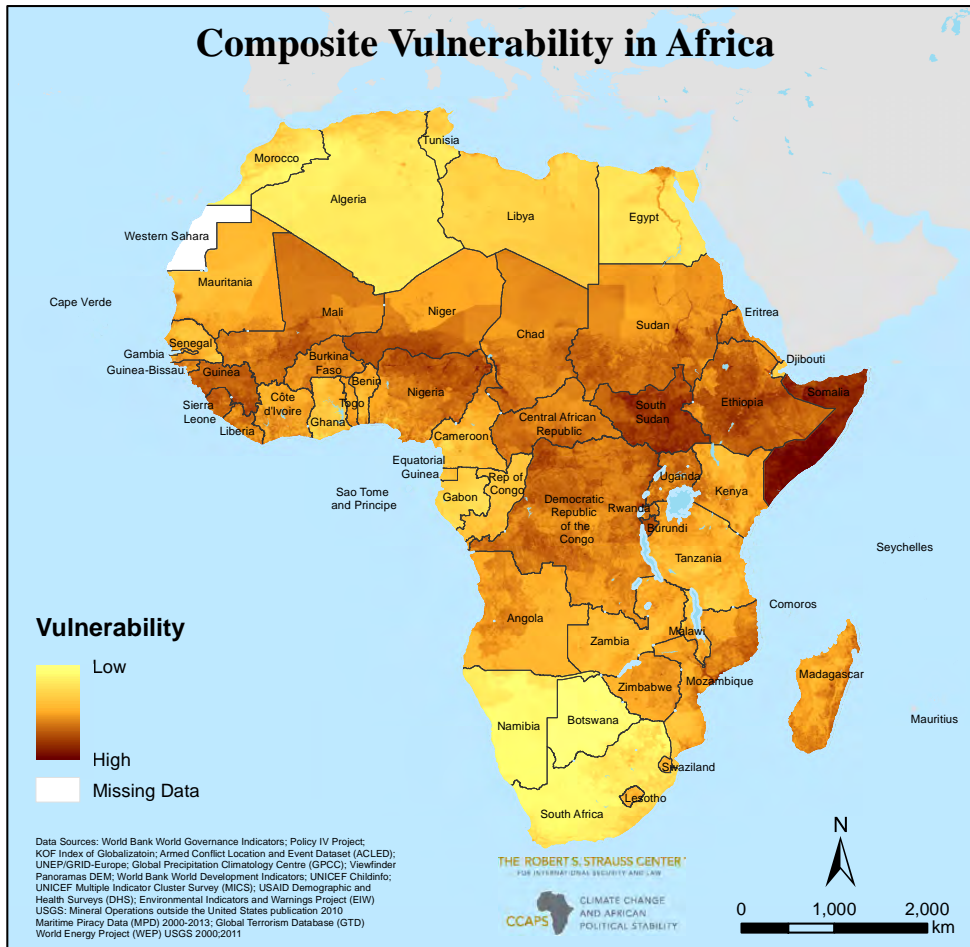
Climate-Related Hazard Exposure in Africa



Physical Exposure Late 20th Century



Comparison of Composites



Final Thoughts

- Maps starting point for research
- Challenges of modeling dynamism
- USG capabilities and support for research

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CLIMATE CHANGE
AND AFRICAN
POLITICAL STABILITY

Outcomes and Impacts of the Conflict Tracking under the CCAPS Program

Clionadh Raleigh

Professor of Political Geography, University of Sussex
Director, Armed Conflict Location and Event Data Project

CCAPS Briefing
Washington, DC
June 23, 2016



ACLED Political Violence and Protest Data project

- Publicly-available geo-referenced dataset of political violence:
 - Date, type, actors, location (co-ordinates; admin)
- Covers all of Africa, select states in South and Southeast Asia
- 1997 – Present (weekly / monthly updates)
- In addition to data:
 - Monthly *African Conflict Trends* and quarterly *Asian Conflict Trends*
 - Country profiles
 - Topic / issue-specific maps and data packages

What is ACLED?

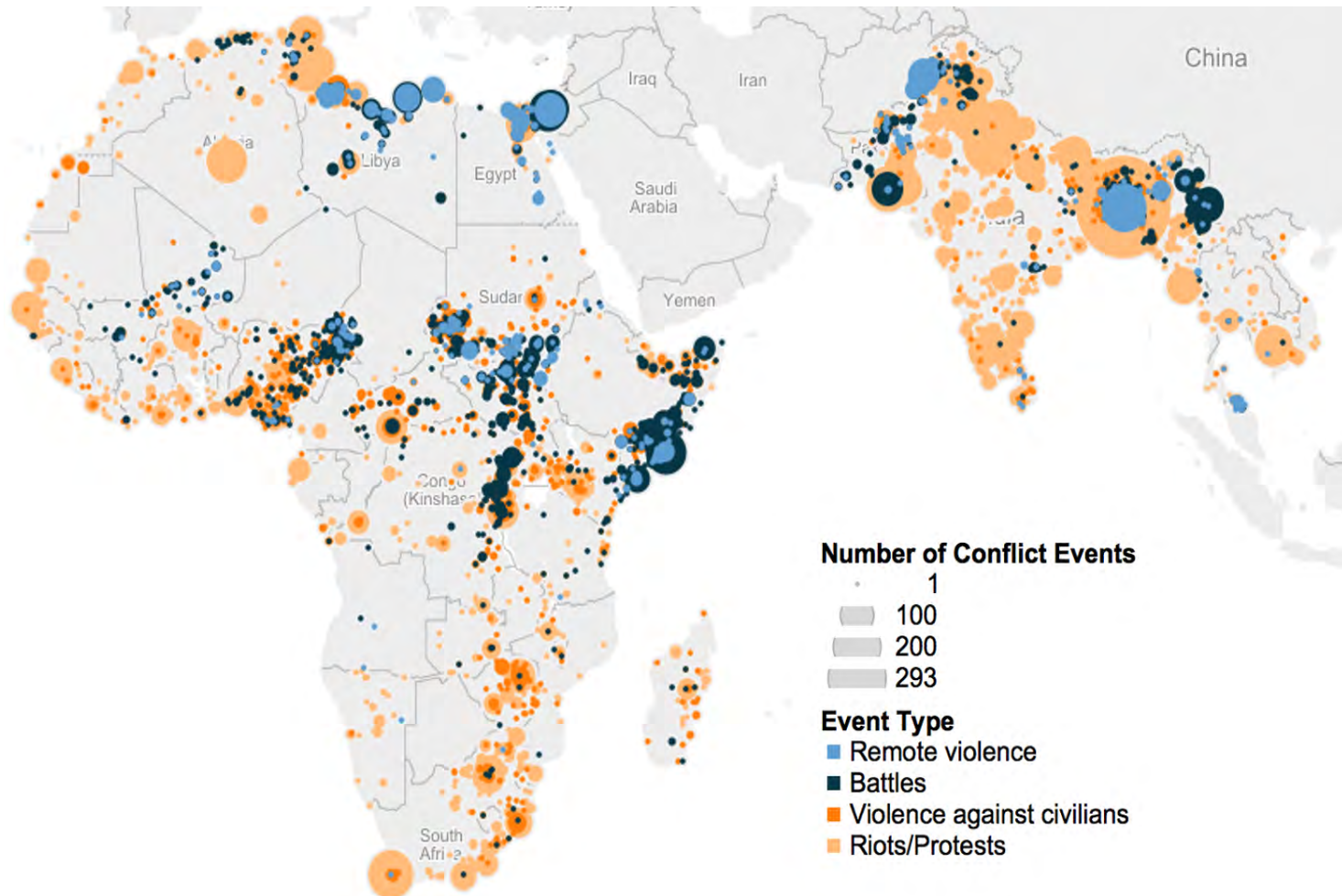
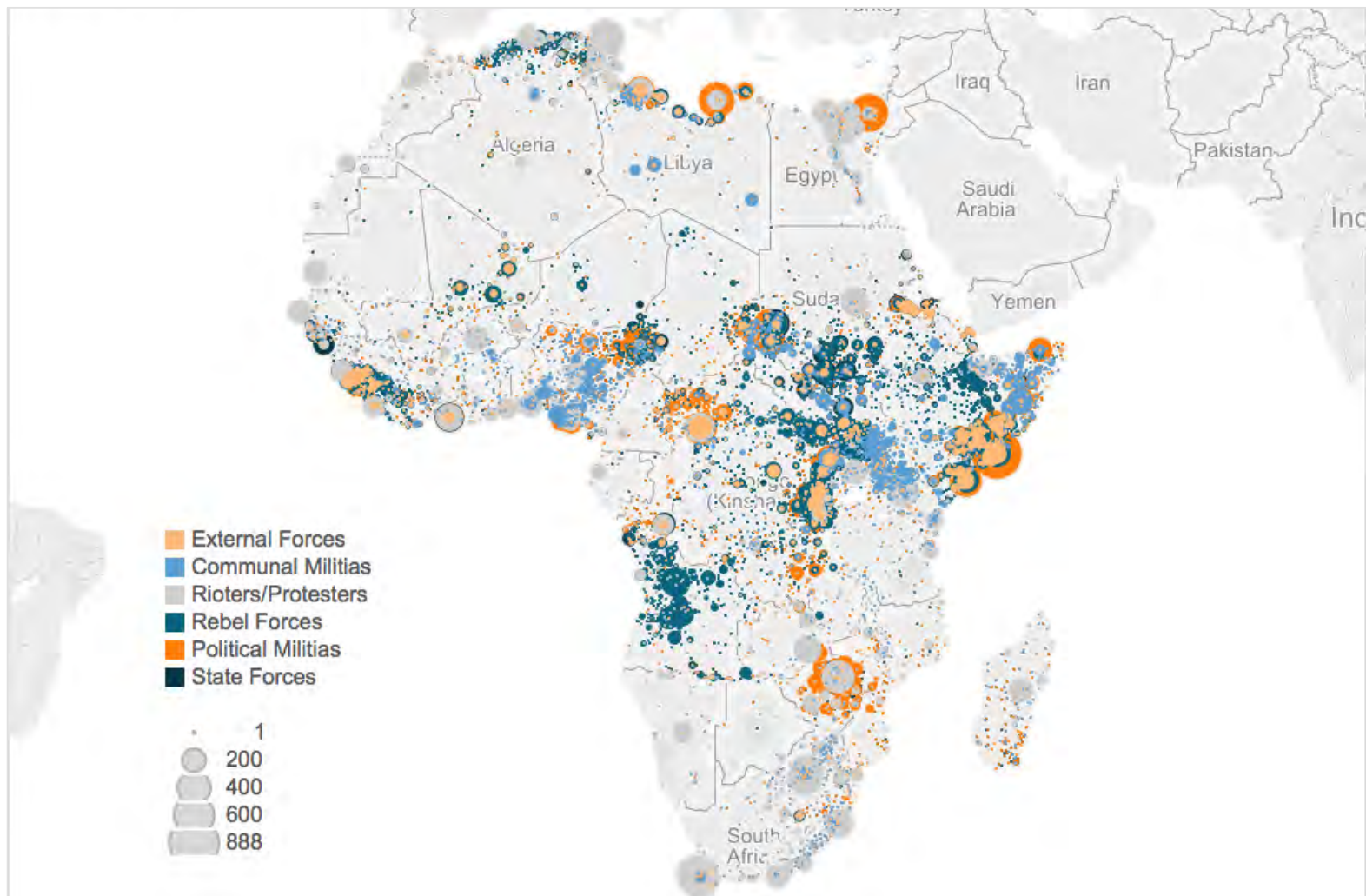


Figure 1: Map of Events across Africa, South and South-East Asia in 2015.

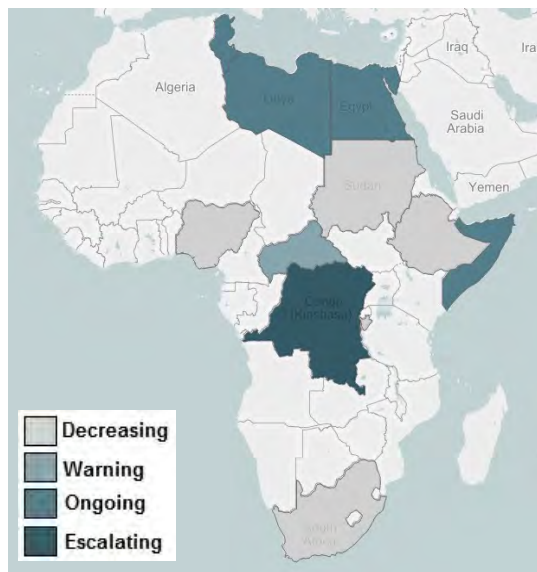


CONFLICT TRENDS (NO. 49)
REAL-TIME ANALYSIS OF AFRICAN POLITICAL VIOLENCE, JUNE 2016

Welcome to the June issue of the Armed Conflict Location & Event Data Project's (ACLED) *Conflict Trends* report. Each month, ACLED researchers gather, analyse and publish data on political violence in Africa in realtime. Weekly updates to realtime conflict event data are published on the [ACLED website](#), and are also available through our research partners at [Climate Change and African Political Stability \(CCAPS\)](#).

This month's issue focuses on a stabilisation in the conflict environment in **Libya**, armed offensives and escalating protests in Eastern **Democratic Republic of Congo**, a geographical shift in clashes between SPLA/M-IO and military forces in **South Sudan**, the impact of the rainy season in **Sudan** on restricting political violence in in South Kordofan, increasing conflict activity in south-eastern **Tunisia** and the threat of Islamic State. A Special Report focuses on local conflict and violence monitors.

Elsewhere on the continent, violence against civilians is witnessing a slight drop in **Burundi** in May, rival armed groups clashed in the Kouï and Bocaranga areas of **Central African Republic**, and protest activity continued to fall in **Ethiopia**.



Conflict Trajectory, June 2016

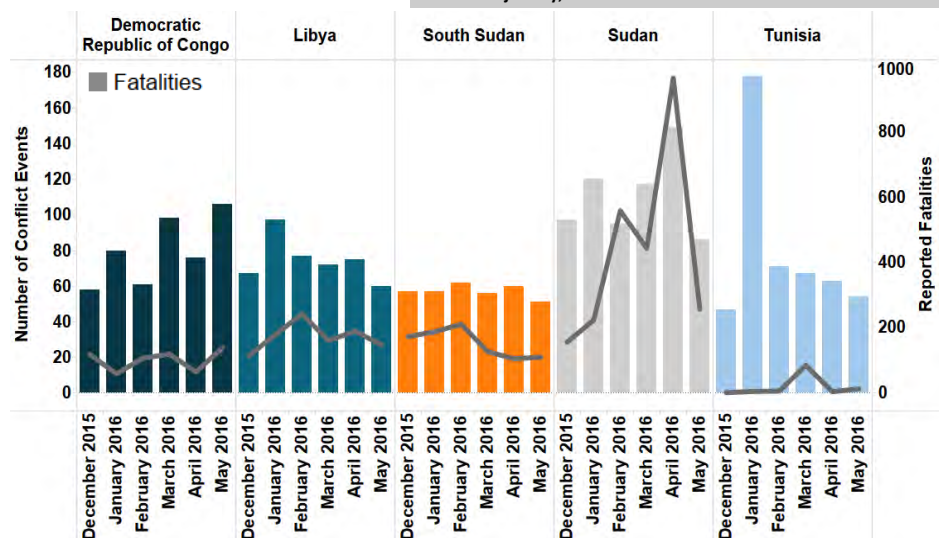


Figure 1: Conflict Events and Reported Fatalities by Country, December 2015 - May 2016.

Monthly Trends

Conflict Trends Reports and Country Profiles

ACLED Conflict Trends reports are monthly updates on political violence and conflict events in African states. They are based on real-time data, and compare current trends and patterns to historical dynamics in key focus countries. The target audience includes policy makers and development and humanitarian practitioners.

[ACLED Conflict Trends Report No. 47 April 2016](#)

Focus on: Chad, Egypt, Mozambique, Uganda and Violence Against Civilians in West Africa. A Special Report focuses on: Leadership Survival and Pro-Government Militias.



[ACLED Conflict Trends Report No. 46 March 2016](#)

Focus on: Democratic Republic of Congo, Ethiopia, Libya, Namibia, South Sudan, Tunisia and Uganda. A Special Report focuses on: Conflict Resilient Investment.



Mapping and Analysis

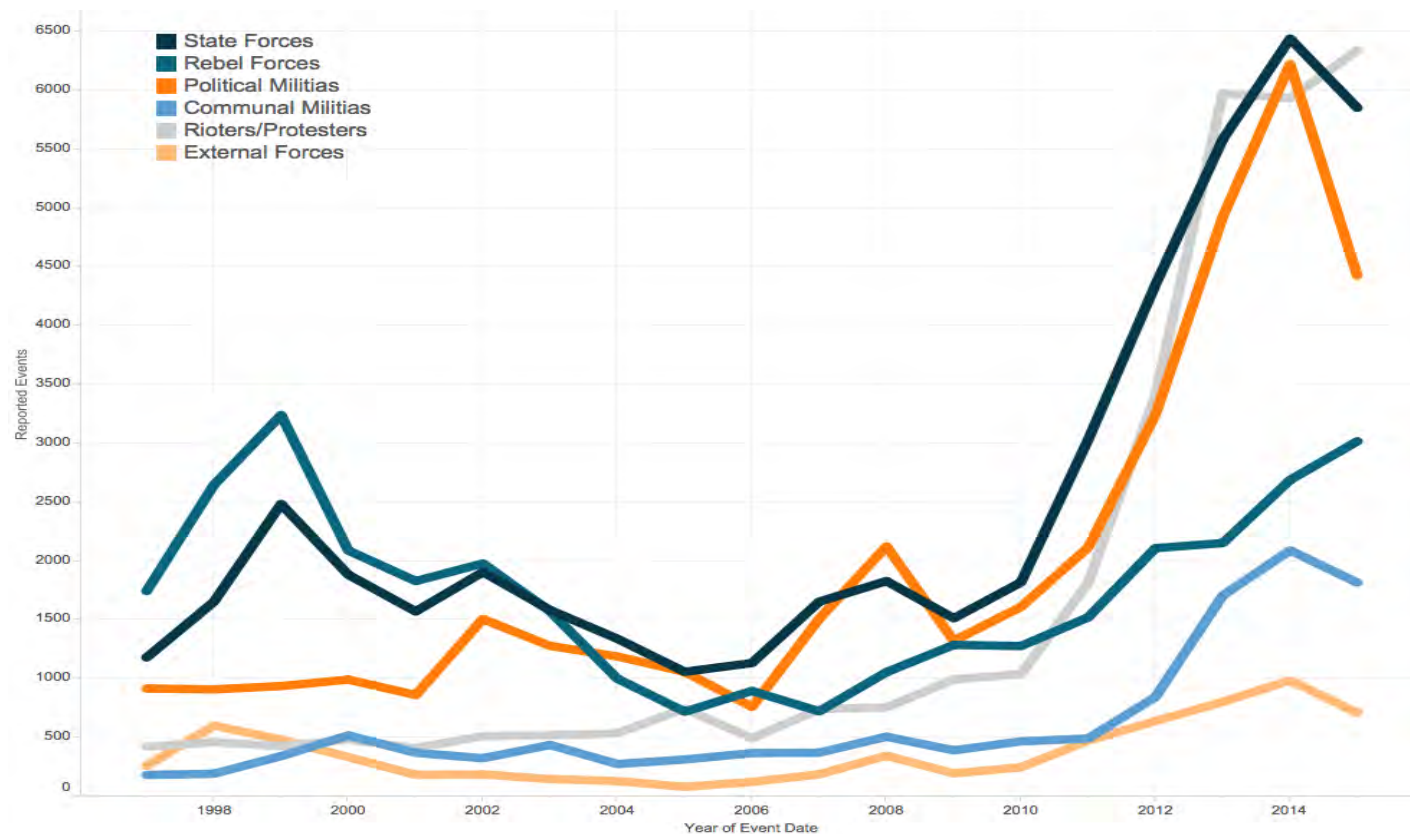


Figure 3: Types of Agent Involved in Political Violence and Protest Across Africa over Time

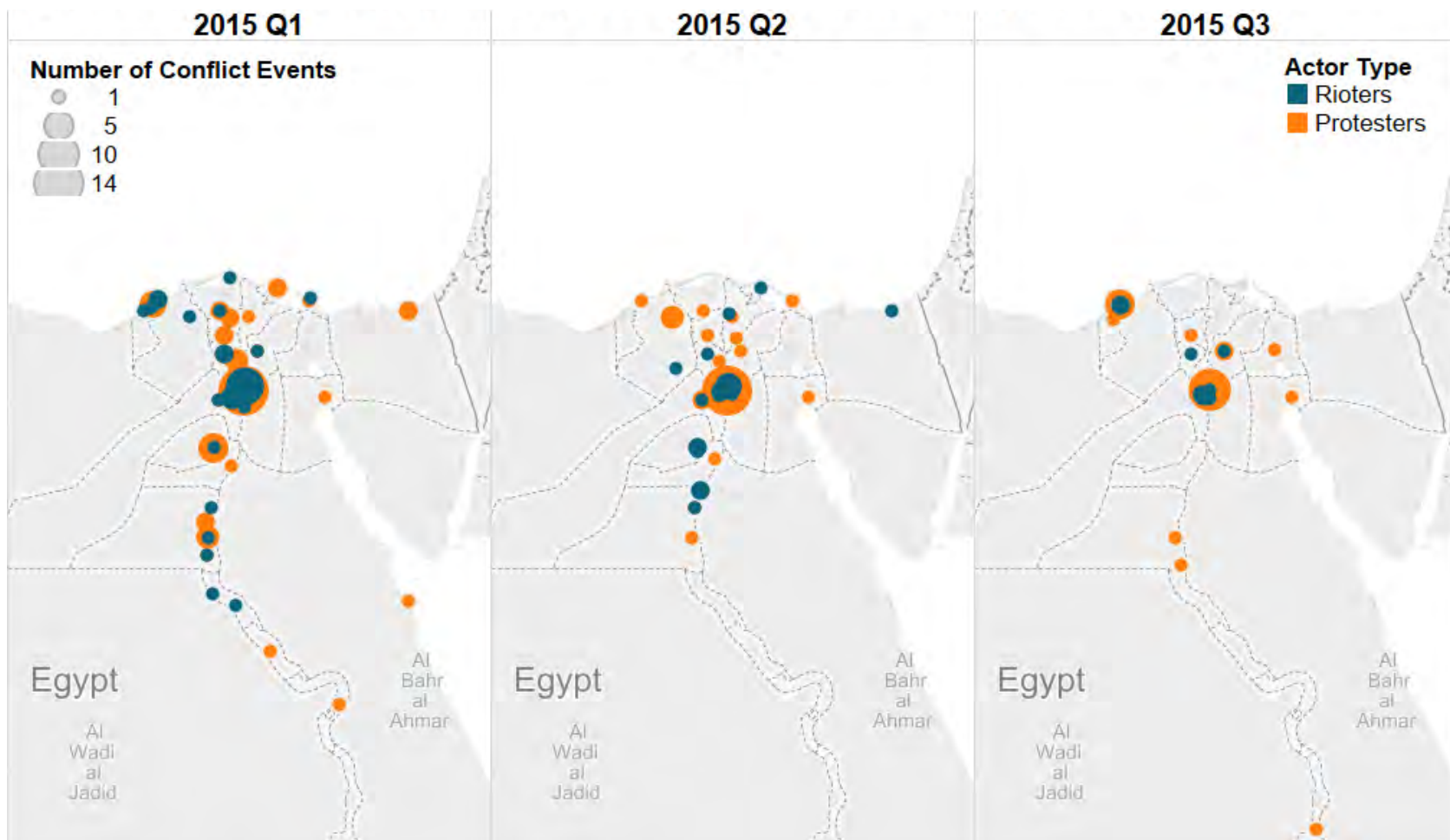


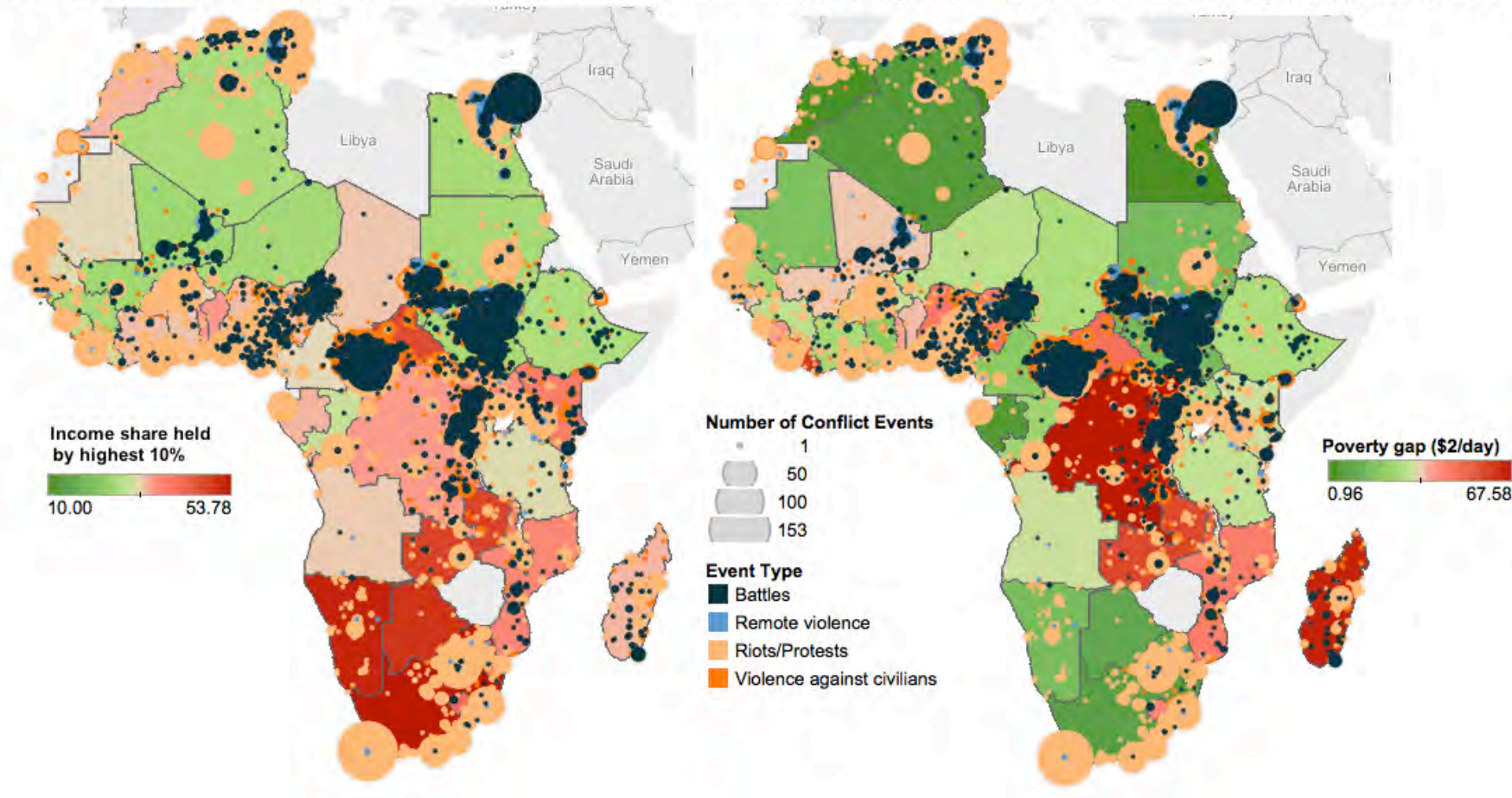
Figure 4: Riots and Protests by Actor Type and Location in Egypt from Q1-Q3, 2015

Contributions and Further Research

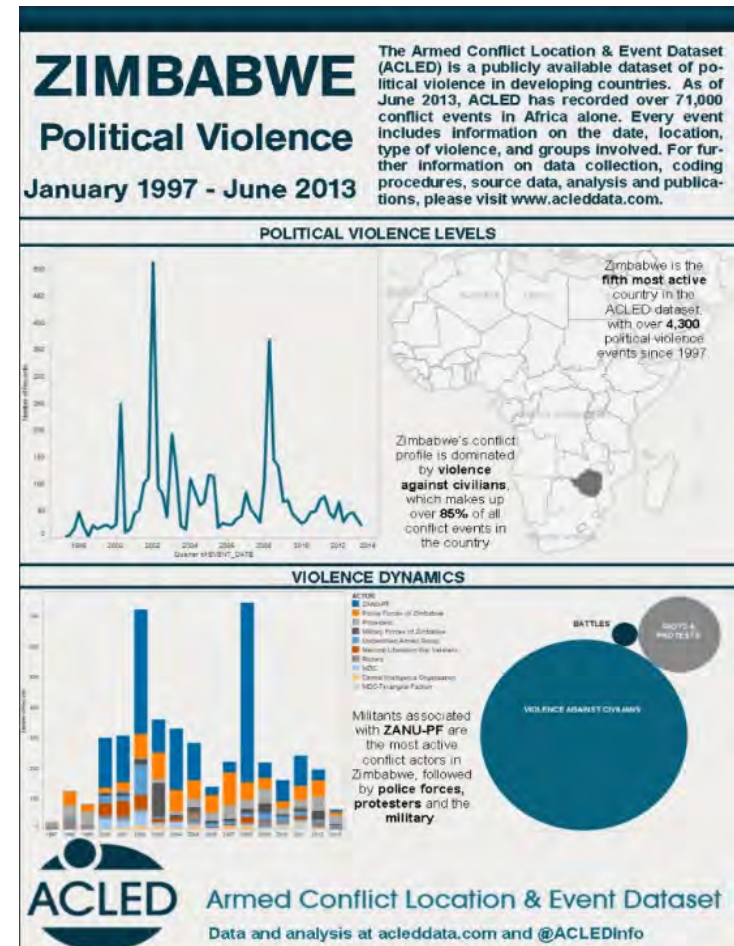
Data illuminates patterns which were previously unknowable to researchers:

- **Capture the locations of violence:** Countries with multiple types of violence have very low rates of spatial overlap between different conflict types.
- **Capture dynamics of violence:** Interest in determining stages of violence – low-grade to organised rebellion; limited evidence across conflict contexts / actor types, defined by actors' relationship, goals.
- **Unpack and compare actor behaviour:** Actors and actor types have discrete conflict profiles, change over time and across actors, e.g. attacks on civilians.

Figure 2: Political Conflict and Inequality as Measured by the Income Share Held by the Highest 10% (left) and the Poverty Gap (right), Africa, 2014-2015

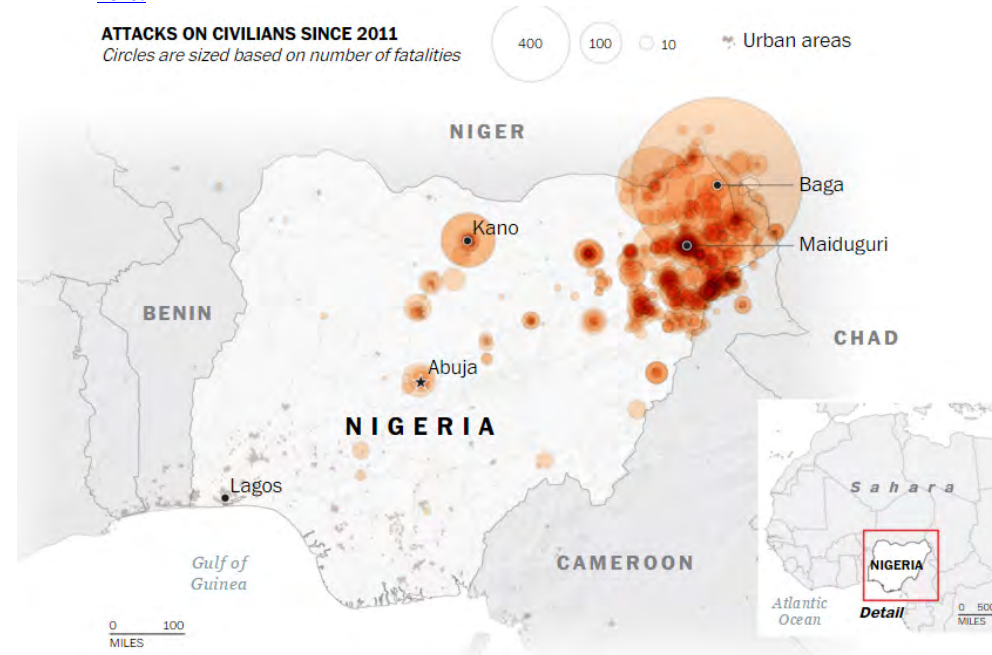


- Tracking rise of intolerance and militant groups across multiple regime types and institutional settings including democratic and authoritarian systems.
- Where is the greatest threat to civilians and by whom? In 2015, Boko Haram was the group with the highest event-civilian fatality ratio.
- Strategies of violence by regimes
- Analysis on the changing forms of organisation, violence and agents of conflict across Africa through dynamic and interactive mapping.

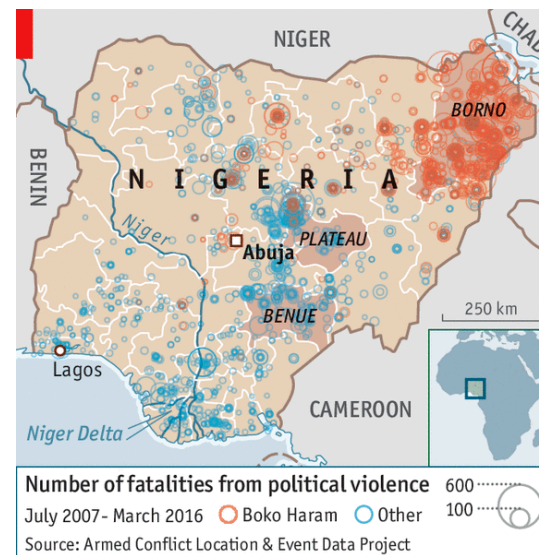


Organizations making use of ACLED Data

- [The Washington Post \(2016\) The brutal toll of Boko Haram's attacks on civilians. 3 April 2016.](#)



- [The Economist \(2016\) Insecurity in Nigeria: Fighting on all fronts. 2 April 2016.](#)



Academic and Public Contributions

- Extreme temperatures and violence (Nature, 2014)
- Governance and conflict in 'ungoverned spaces' (Stability, 2013)
- An analysis of conflict and climate connections in East Africa (JPR, 2012)
- Search for safety- Migration in a time of climate change (GEC, 2011)
- Political marginalization, climate change and conflict (ISR, 2011)
- Seeing the forest for the trees- the effects of physical geography on conflict (II, 2010)
- Introducing ACLED (JPR, 2010)

Briefs

- Conflict Trends (50 published through June 2016)
- Multiple Country Reports
- Complex Emergencies
- Migration, Urbanization and Political Power across Africa
- Tracking Islamist Groups

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Urban Resilience to Climate Change in Africa

Robert H. Wilson

Mike Hogg Professor of Urban Policy, LBJ School of Public Affairs
University of Texas at Austin

CCAPS Briefing
Washington, DC
June 23, 2016

Urban Resilience to Climate Change Challenges in Africa

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LYNDON B. JOHNSON
SCHOOL OF PUBLIC AFFAIRS

POLICY RESEARCH PROJECT REPORT

184

**Are governance systems in urban Africa
developing the resilience needed to face
climate change challenges, thereby
enhancing the collective well-being of
these populations?**

Research Methodology

Exploratory and broad-brushed

Comparative case study of local government

Ten large African cities

Research team and field research

Why large cities?



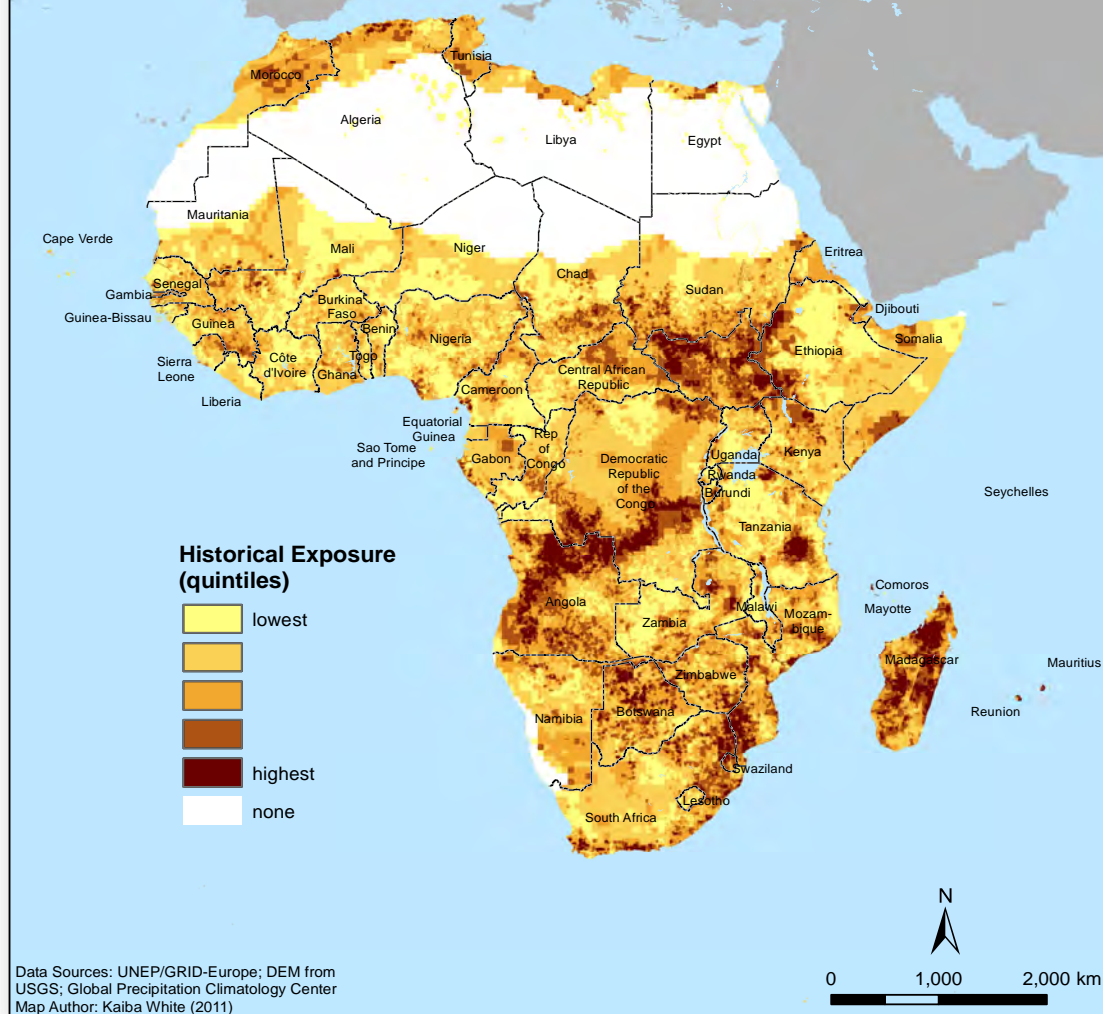
City	City Population (2010)	City Growth Rate (2000-2010) (%)	City as a Share of National Population (2010) (%)	National GDP per Capita (2011, Constant 2000 \$US)
Accra	2,342,000	3.4	9.6	402
Alexandria	4,387,000	2.0	5.4	1977
Cape Town	3,405,000	2.3	6.8	3825
Casablanca	3,284,000	0.8	10.3	1908
Dakar	2,863,000	3.4	23.0	560
Dar es Salaam	3,349,000	4.6	7.5	473
Johannesburg	3,670,000	2.9	7.3	3825
Kampala	1,598,000	3.8	4.8	392
Luanda	4,772,000	6.1	25.0	630
Maputo	1,655,000	4.1	7.0	401

Source: UN Population Fund, World Development Indicators, World Bank

RESEARCH QUESTION #1

How will the consequences of future climate change affect people living in African cities and what determines the vulnerability to these exposures?

Climate Related Hazard Exposure in Africa



Exposures to Climate Hazards

1) Storms and flooding

- Most common hazard across the ten cities and frequently occurring
- Immediacy leads to high priority by local governments

2) Drought and water scarcity

- Slow-onset threat but one that experts believe is a major threat
- Involves regions beyond the city itself, often transnational resources

3) Sea level rise

- An accepted threat but slow-onset
- Saltwater intrusion into ground water, several current cases
- Increased threat from storm surge possible near term risk

Factors Affecting Vulnerabilities

- 1) Location and geography—coastal, riverine systems, ecosystems—large cities are usually port cities**
- 2) Historic settlement patterns—especially informal settlements**
- 3) Urban planning effectiveness and infrastructure deficits**
- 4) Exposure of economic assets, especially in ports and adjacent CBD and public sector buildings**

Key Findings to Question #1

Current urban planning and service provision practices exacerbates vulnerabilities, independent of climate change hazards

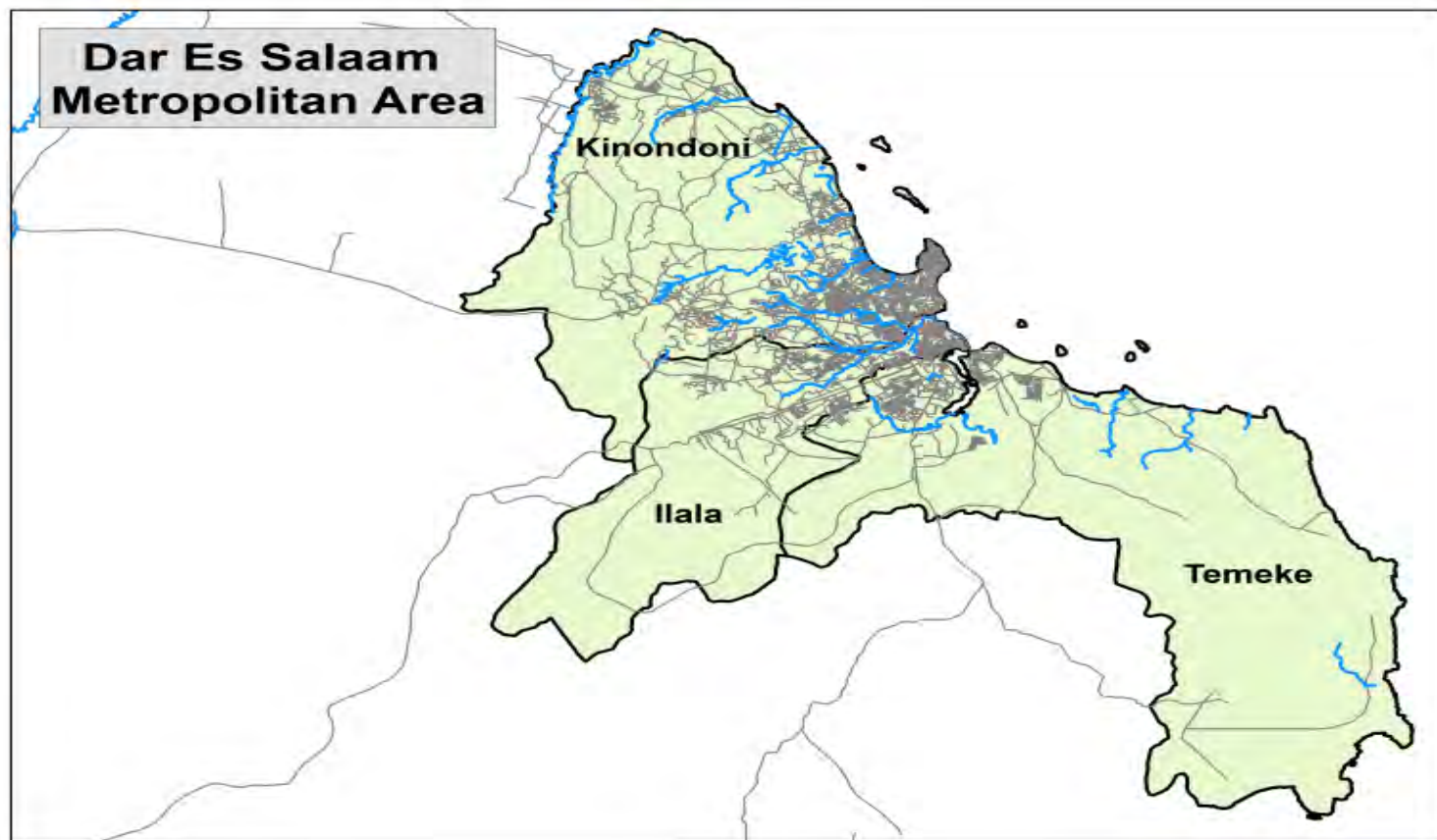
Rapid urban growth, including rural-urban migration, places pressure on planning and informal settlements

Under the current trajectory, vulnerabilities to climate change in African cities will grow

RESEARCH QUESTION #2

Are resilience initiatives being adequately and sustainably implemented and what factors affect the efficacy of such initiatives?

**Dar Es Salaam
Metropolitan Area**



Developing Resilience Policy and Initiatives by Local Governments

1) Effects of national adaptation agendas

- Climate change policy is on the national agendas
 - NAPAs in the LDC countries
 - Support of international actors
- Priorities for mitigation vs adaptation; rural vs urban

2) National-local government relations

- Policymaking capabilities and local government authority
- Intergovernmental relations

Resilience Policy and Initiatives (continued)

3) Local Agenda Setting

- Local priorities responsive to immediate needs and pressures
- Constraints on authority and resources limit effectiveness of policymaking and planning
- Local climate risk assessments are available but not well integrated into local planning

4) Nongovernmental actors support resilience efforts

- Substantial understanding of local climate change hazards, but often developed outside local government

Key Findings to Question #2

Local governments rarely engage in policymaking and planning explicitly motivated by consequences of climate change

National governments both empower and impede climate change initiatives in local governments

Local government agenda setting is heavily influenced by short term needs, especially rapid onset climate hazards

International actors increasingly engaged in local climate change initiatives but roles must be tailored to local institutional context

RESEARCH QUESTION #3

Are resilience initiatives being adequately and sustainably implemented and what factors affect the efficacy of such initiatives?

Factors Affecting Implementation of Local Resilience Initiatives

- 1) Organizational structures and authority of local government**
 - Incomplete decentralization and reform
 - Issues of geographic mismatch—hazard footprint and government jurisdictions
 - Notable cases of effective networks of organizations
- 2) Resource availability**
 - Level of national development is important, but not decisive
 - Very limited ability to raise local resources
 - Less international support for implementation than for assessments

Implementing Resilience Initiatives (continued)

3) Urban planning and infrastructure provision

- Weak planning instruments, often not applied in informal settlements
- Plans and controls not followed, competing objectives
- Relocation of informal settlements has produced mixed results
- Some efforts to enhance local planning capabilities

4) Many promising instances of NGOs and CBOs contributing to the building of resilience

- Most common in informal settlements
- Collaboration with governmental agencies and international organizations
- Focus in informal settlements is helpful and instructive, but without the scale needed for broad impacts

Project Findings

- 1) Local governments in large cities are critical but underutilized actors in addressing climate adaptation**
- 2) Local governments face competing priorities and have limited capacity, effective intergovernmental (vertical and horizontal) relations are absent**
- 3) For local governments, planning for climate change adaptation is an extraordinarily complex agenda**
- 4) Partnerships and collaboration for developing urban resilience will be required**

Progress toward climate change adaptation in urban Africa can be observed, but local governance and urban planning systems have yet to develop the capacity to build resilience needed for the the collective well-being

Project Publications

Full Report: *Urban Resilience to Climate Change Challenges in Africa*, Policy Research Project #184, 2015, CCAPS.

<https://repositories.lib.utexas.edu/handle/2152/31021>

Research Briefs #29 and #30 “Climate Change Resilience in Urban Africa” Part I: The Policy Challenge; Part II: The Resilience Policy Agenda, CCAPS, 2015.

Teaching Module #3. “Climate Change and Cities in Africa: Current Dilemmas and Future Challenges, CCAPS, 2014.

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Climate Change and Development: The Aid Scramble

Dr. Kate Weaver

Associate Professor, LBJ School of Public Affairs
Co-Director, Innovations for Peace and Development
The University of Texas at Austin

CCAPS Aid Team Leads: Dr. Kate Weaver (UT), Dr. Michael Findley (UT), Ms. Nisha Krishan (UT), Mr. Justin Baker (UT/), Ms. Krista Rasmussen (UT/Brookings Institution), Mr. Christian Peratsakis (UT/Socrata), Mr. Josh Powell (Development Gateway)

With grateful acknowledgments to the many UT students who contributed to this work and our partners at the Development Gateway, AidData, ESRI, the World Bank, and USAID



Tracking Aid for Climate Change and Development



Driving Questions:

- How can we identify and track international aid resources that support mitigation and adaptation activities in Africa, in line with international agreements?
- How can we use this information to assess whether or not climate aid is reaching populations and regions with the greatest vulnerability to climate change and greatest need for external resources?
- How can we establish *practical* methods for financial and geographical tracking that will be useful for decision makers, within donor governments and agencies as well as government and CSO partners in developing countries?



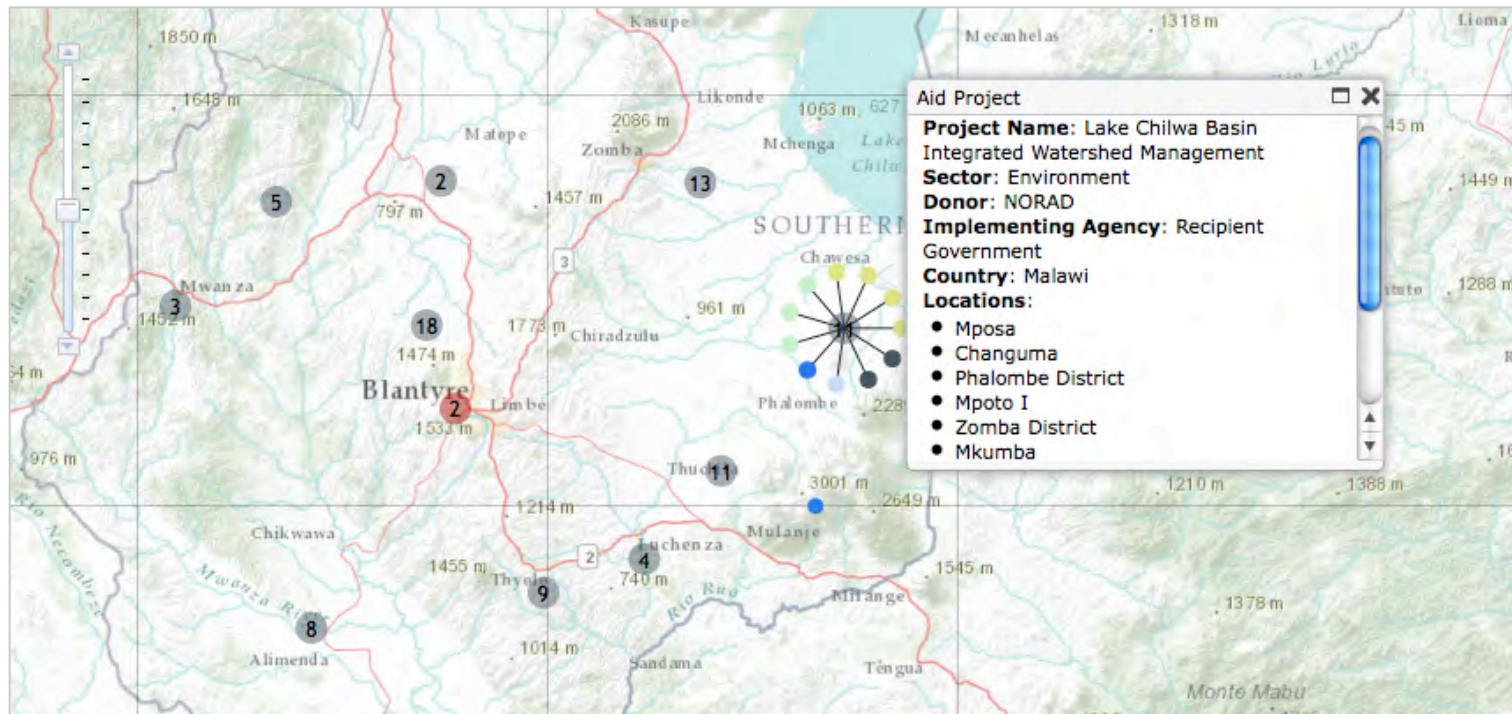
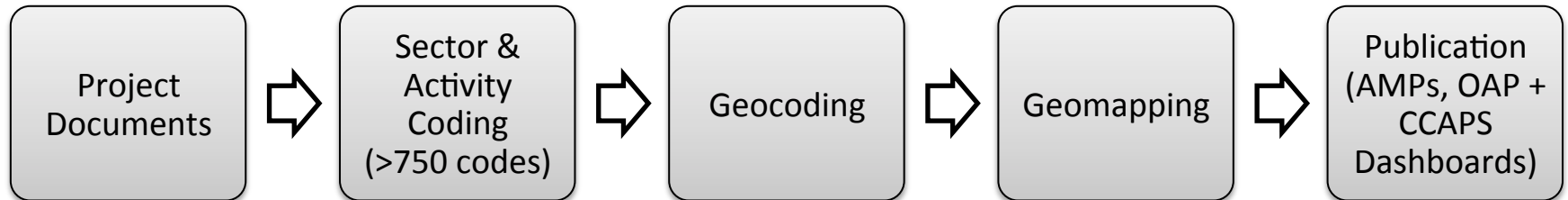
Tracking Aid for Climate Change and Development

Objectives:

- Develop methodology for coding and mapping subnational aid activities to provide publicly accessible, timely and comprehensive information on aid flows in Africa
- Develop useable/ scalable methodology for identifying mitigation and adaptation activities within official development assistance flows to track climate resources
- Modify climate aid methodology to track and map aid for food security
- Show *proof of concept* on all the above objectives, and network with IGOs, Governments, Think Tanks and CSOs to adopt and scale this work for sustainable impact

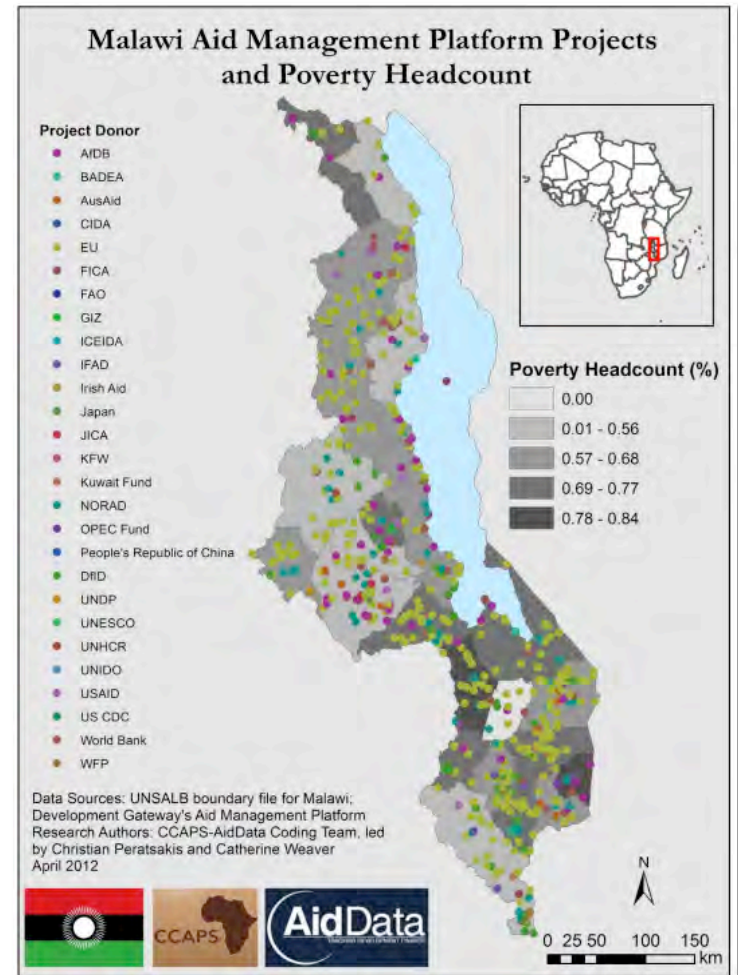


Aid Mapping

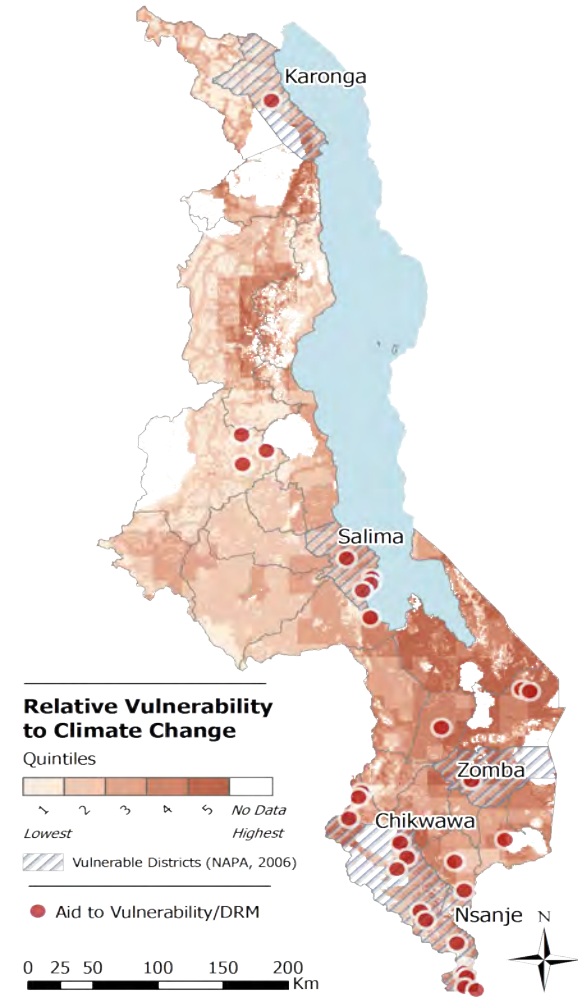
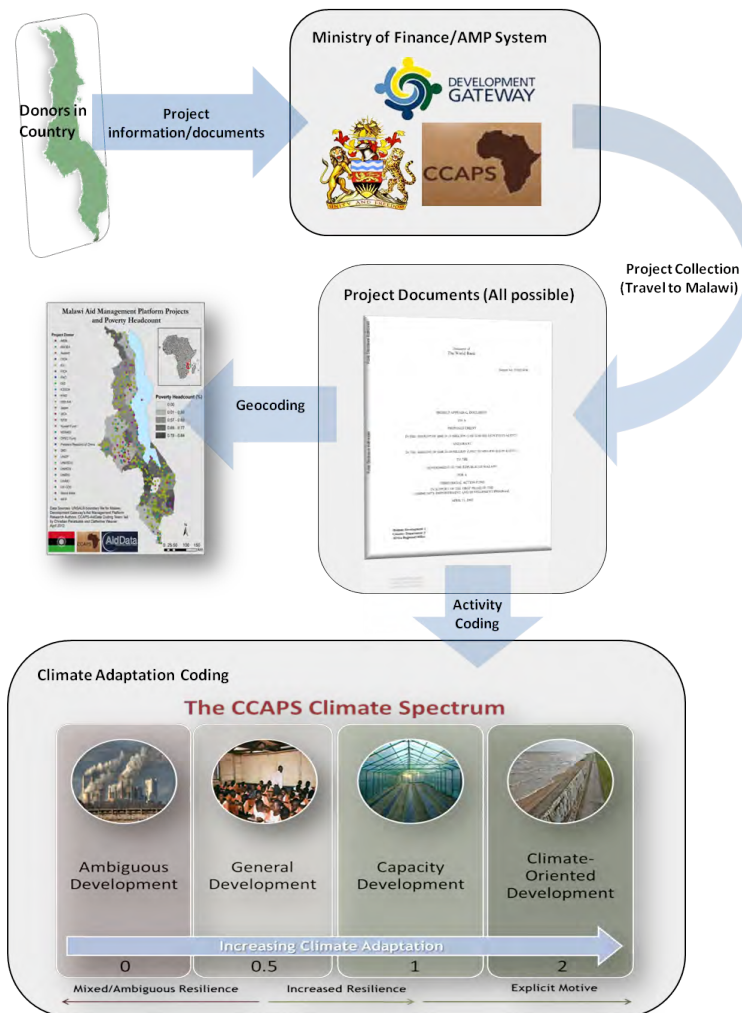


Results & Impact of Aid Mapping

- First multi-donor open aid map (Malawi)
- \$25 million USAID Higher Education Solutions Network grant (with AidData, Development Gateway, and ESRI) to scale subnational, open aid mapping and analysis (2012-2017)
 - Multi-donor aid mapping in Uganda, Senegal, Haiti, Timor Leste, Nepal, Honduras
 - Country level case studies of opportunities and challenges regarding generation and use of aid transparency
- Geocoding standards of major aid donors and International Aid Transparency Initiative (IATI)

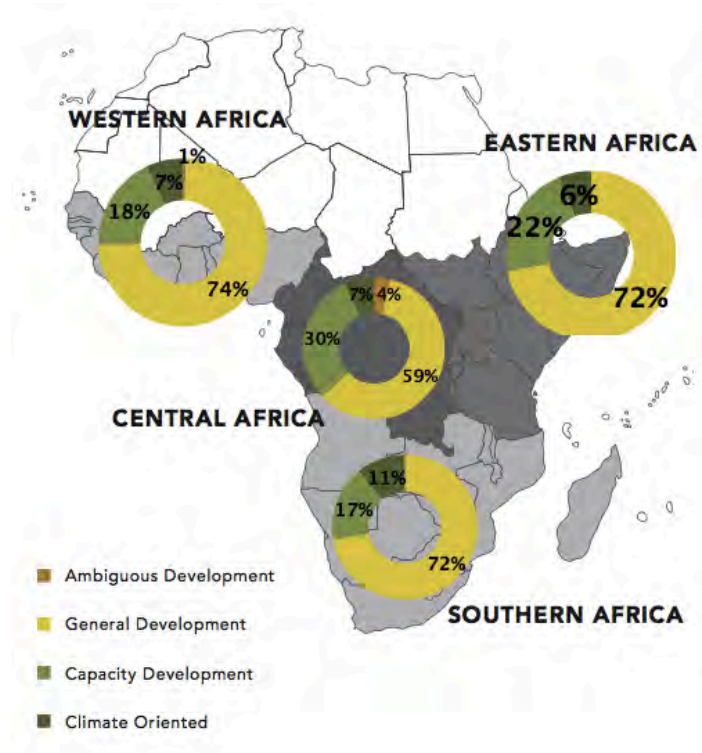


Coding and Mapping Climate Aid

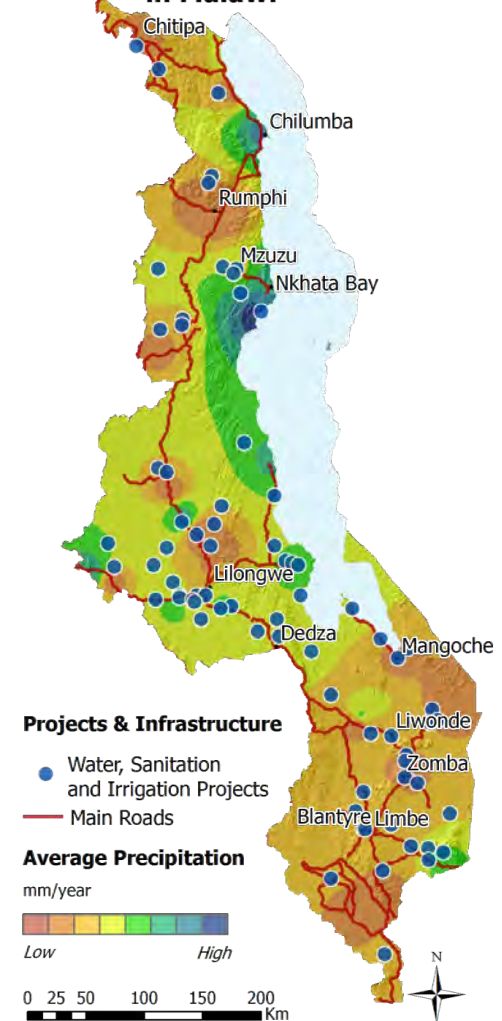


Results & Impact of Climate Aid Work

- Pilot of climate security coding/mapping of all 27 donors in country
- Climate coding all World Bank and AfDB projects in Africa
- MDB Common Principles & Method for Climate Change Adaptation Finance Tracking
- WRI, ODI, Oxfam Adaptation Tracking Initiative

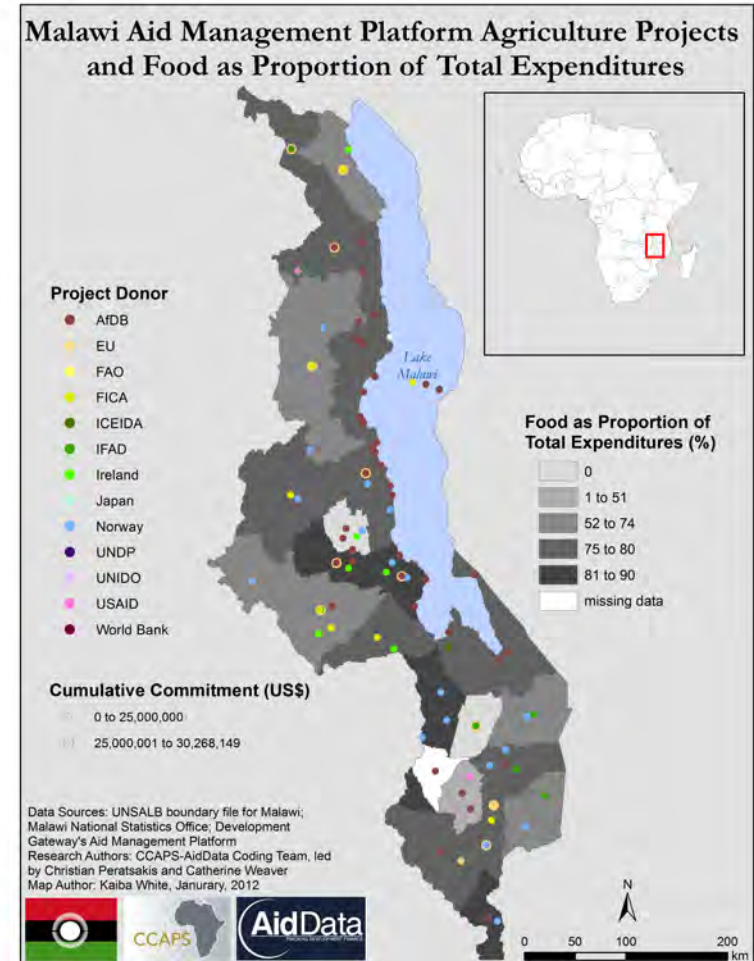
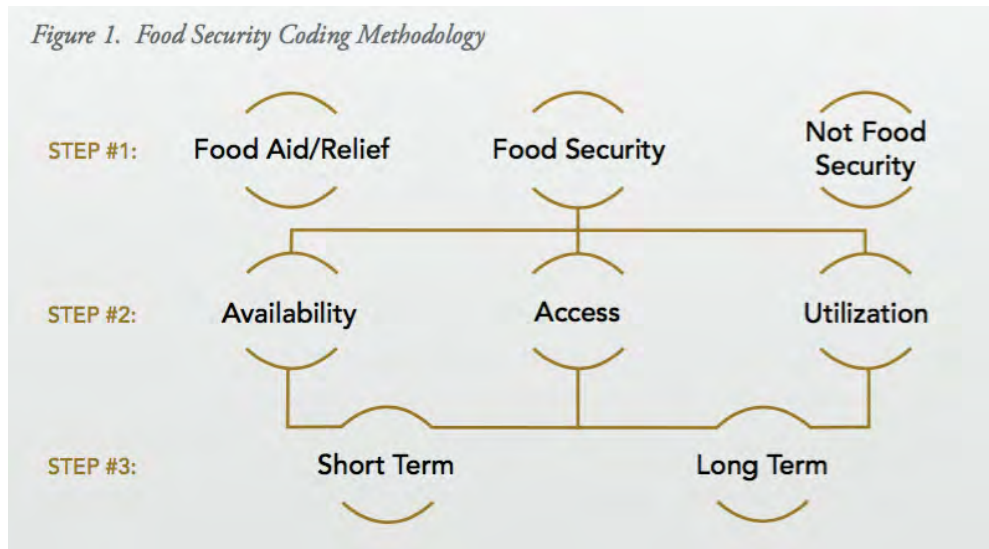


Water Projects and Rainfall in Malawi

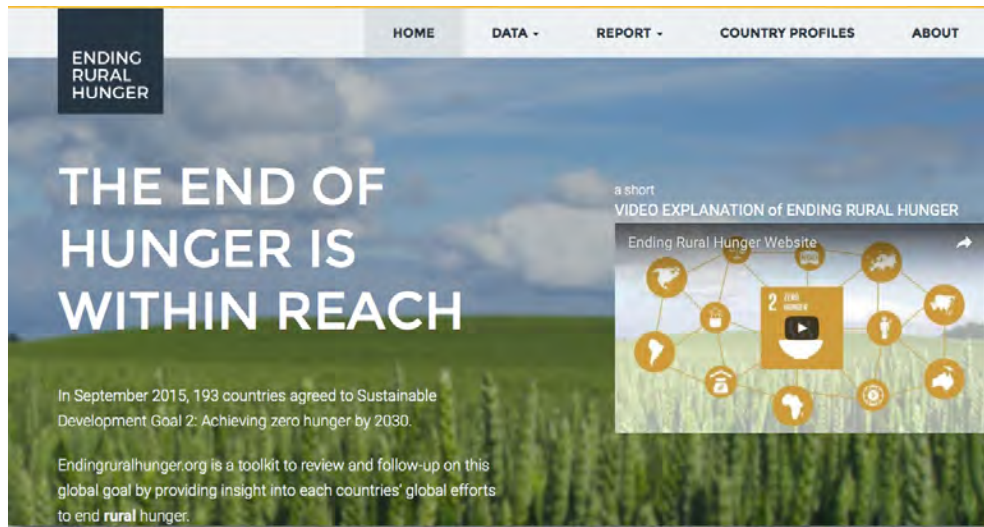


Coding and Mapping Aid for Food Security

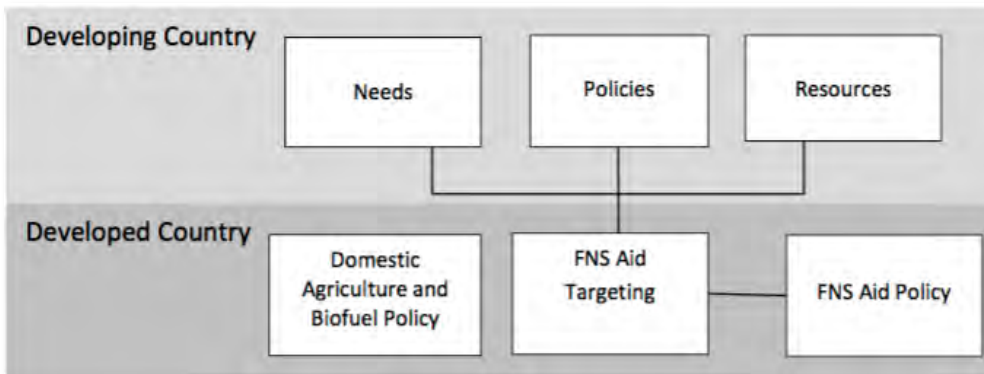
Figure 1. Food Security Coding Methodology



Results & Impact of Food Security Work



- Pilot of food security coding/ mapping in Malawi with top five donors Sectoral analysis
- Work with Brookings Institution Ending Rural Hunger project and UN SDG2 Accountability Working Group
- Forthcoming work with Eleanor Crook Foundation on Food Security Analysis in SSA & implementation of \$750,000 Challenge Grants for Small-Scale Interventions to Improve Local Food Security & Nutrition



Research & Policy Agenda

- Continue working with partners to apply and scale climate and food security tracking methods & analysis
- Continue work with government and partners on advocacy & outreach in international aid transparency
- Cross-national case studies and impact evaluations of open aid data uptake and use
- Curriculum development and professional placement of students working on aid transparency, climate change and food security



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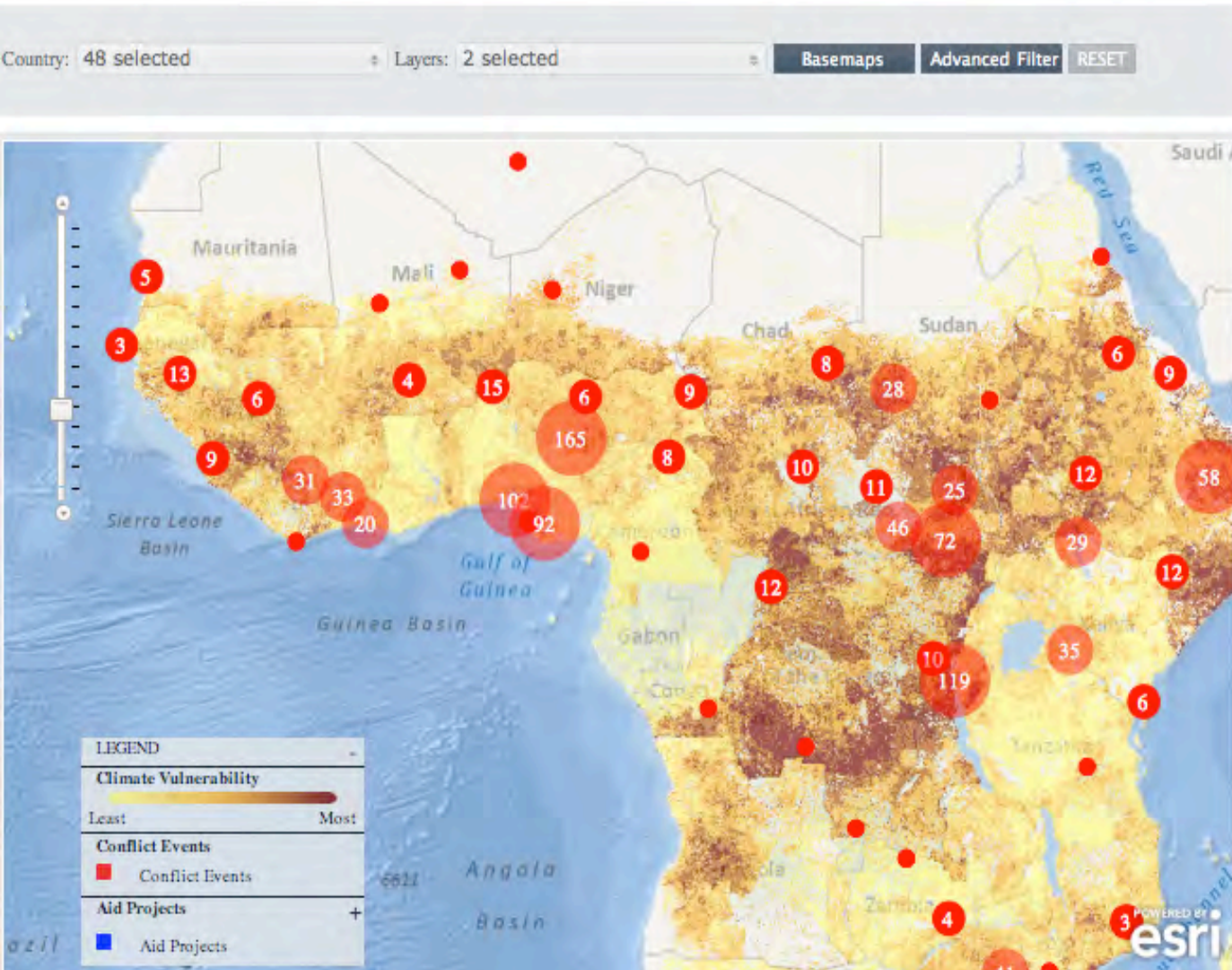
Mapping Tools to Integrate Climate, Conflict, and Aid

Ashley Moran

Distinguished Scholar, Robert S. Strauss Center
Director, CCAPS Program
University of Texas at Austin



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Aid Governance Conflict Climate

About Our Security Vulnerability Data

CCAPS climate security vulnerability data provides information on four sources of vulnerability: physical exposure to climate-related hazards, population density, household and community resilience, and governance and political violence. Chronic climate security vulnerability is located where these four sources of vulnerability conjoin. View the [data sources](#) for the CCAPS climate security vulnerability model here. The climate security vulnerability model includes ACLED conflict events; an alternative model without these events is used when displayed with an overlay of ACLED events.

Learn More

CCAPS seeks to identify which parts of Africa are most vulnerable to climate change-and why-at the most detailed scale possible.

- > Where are the most vulnerable places in Africa?
- > How does CCAPS pinpoint chronically insecure regions?

INTEGRATED MAPPING TOOL: CCAPS mapping tool joins climate, conflict, and aid data

How are conflict patterns changing?

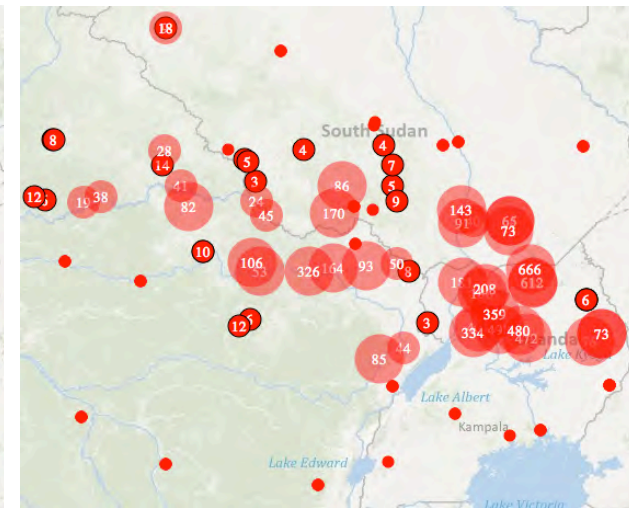
For example, conflict events involving the Lord's Resistance Army (LRA) gradually diffused across Uganda's borders...



1996 – 2000



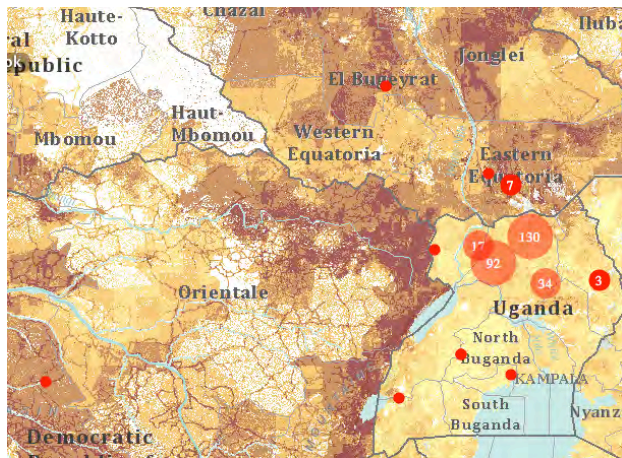
2001 – 2005



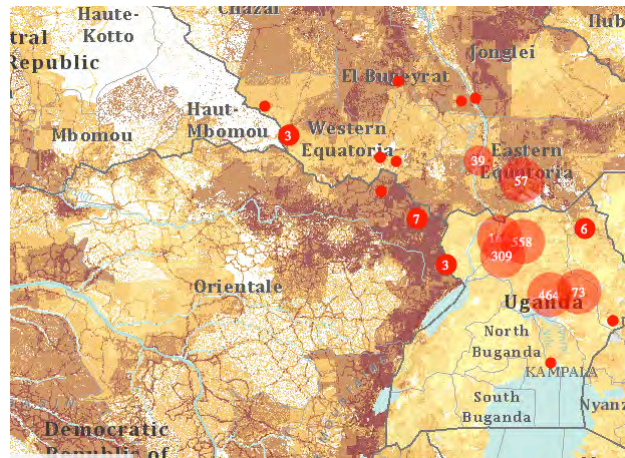
2006 - 2010

...and where do these conflicts compound climate-related vulnerabilities?

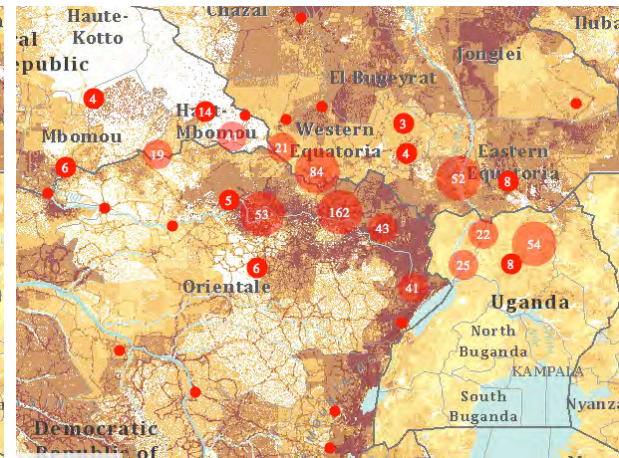
LRA conflict events diffused into areas with less stability and more climate insecurity like South Sudan and northern DRC. These conflict and climate stressors presents dual challenges for security and development.



1996 – 2000



2001 – 2005

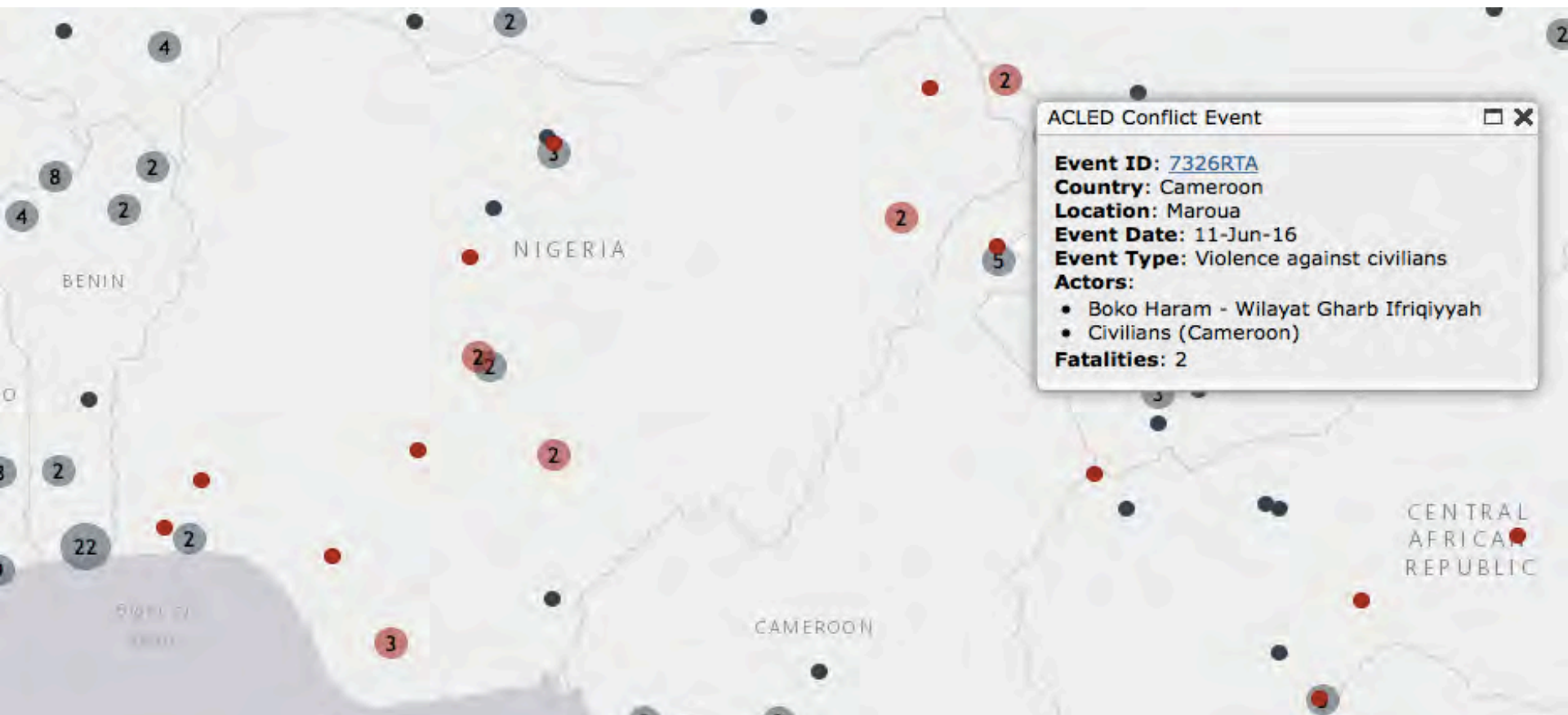


2006 - 2010

What emerging conflicts could impact development projects?

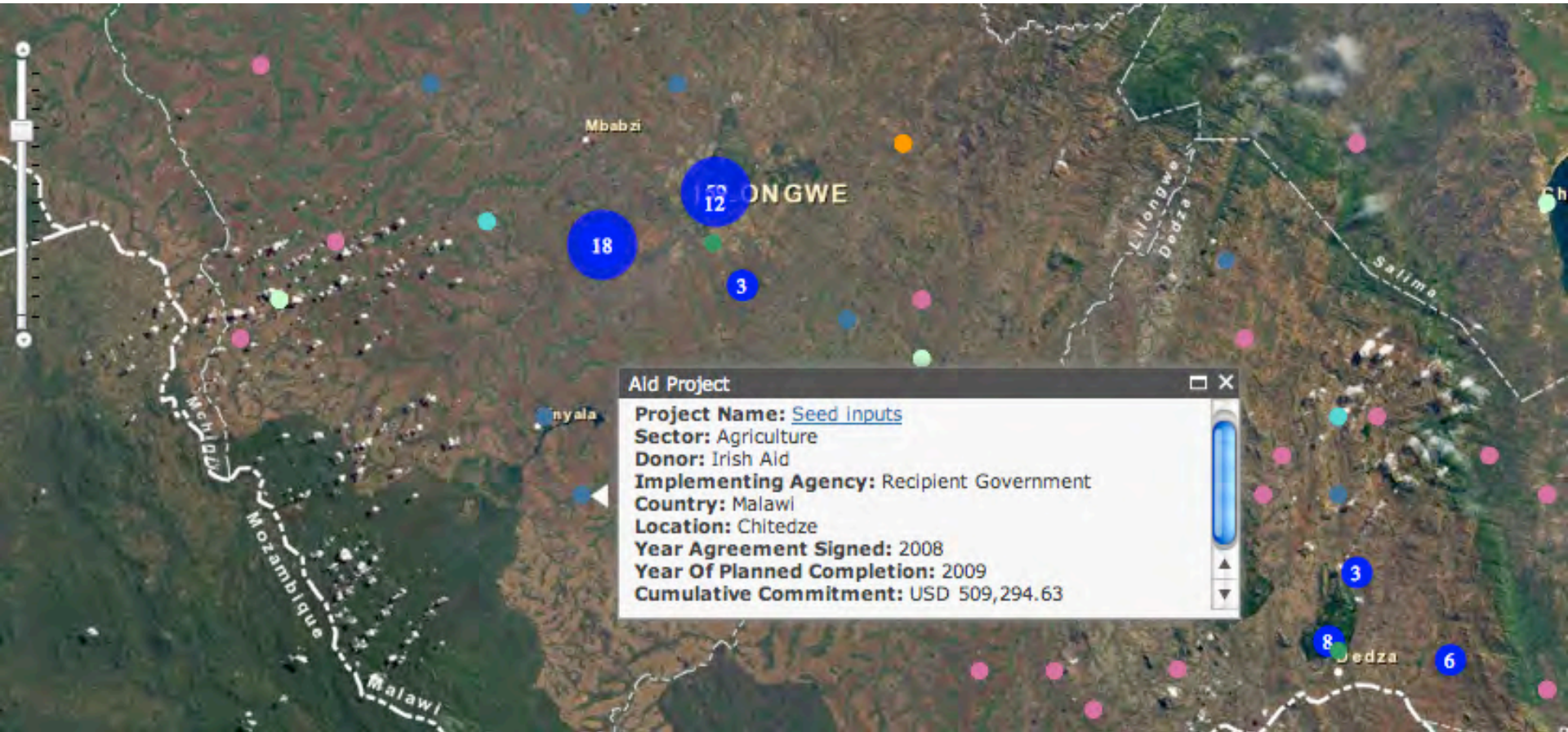
Violence against civilians (in red) often coincides with aid project locations (in gray). With violence against civilians being an important barrier to development in conflict-affected countries, tracking the locations and actors involved in these events is key.

June 2016



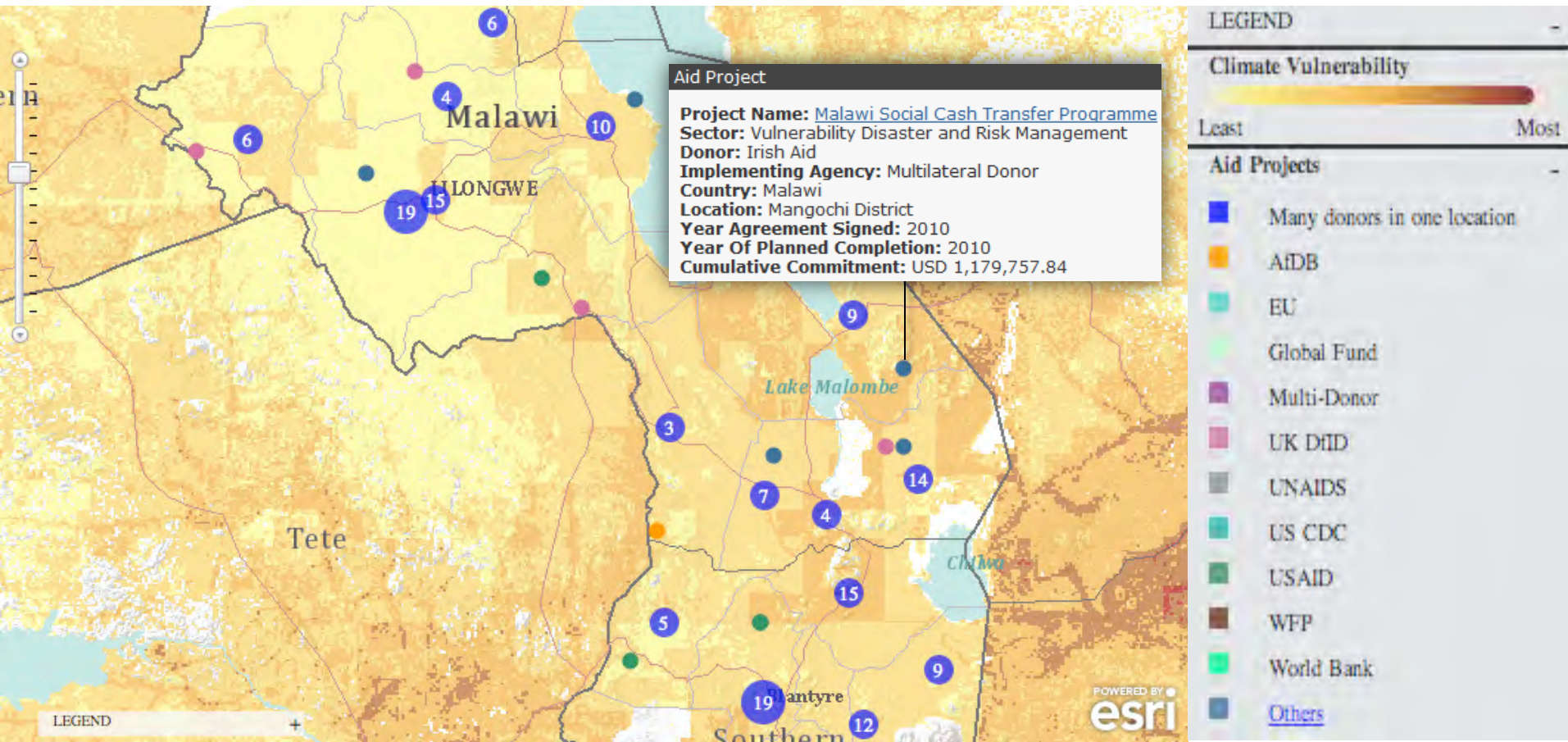
Is aid targeting areas of greatest climate security risks?

Geocoded aid projects are visualized in CCAPS' mapping tool.



Is aid targeting areas of greatest climate security risks?

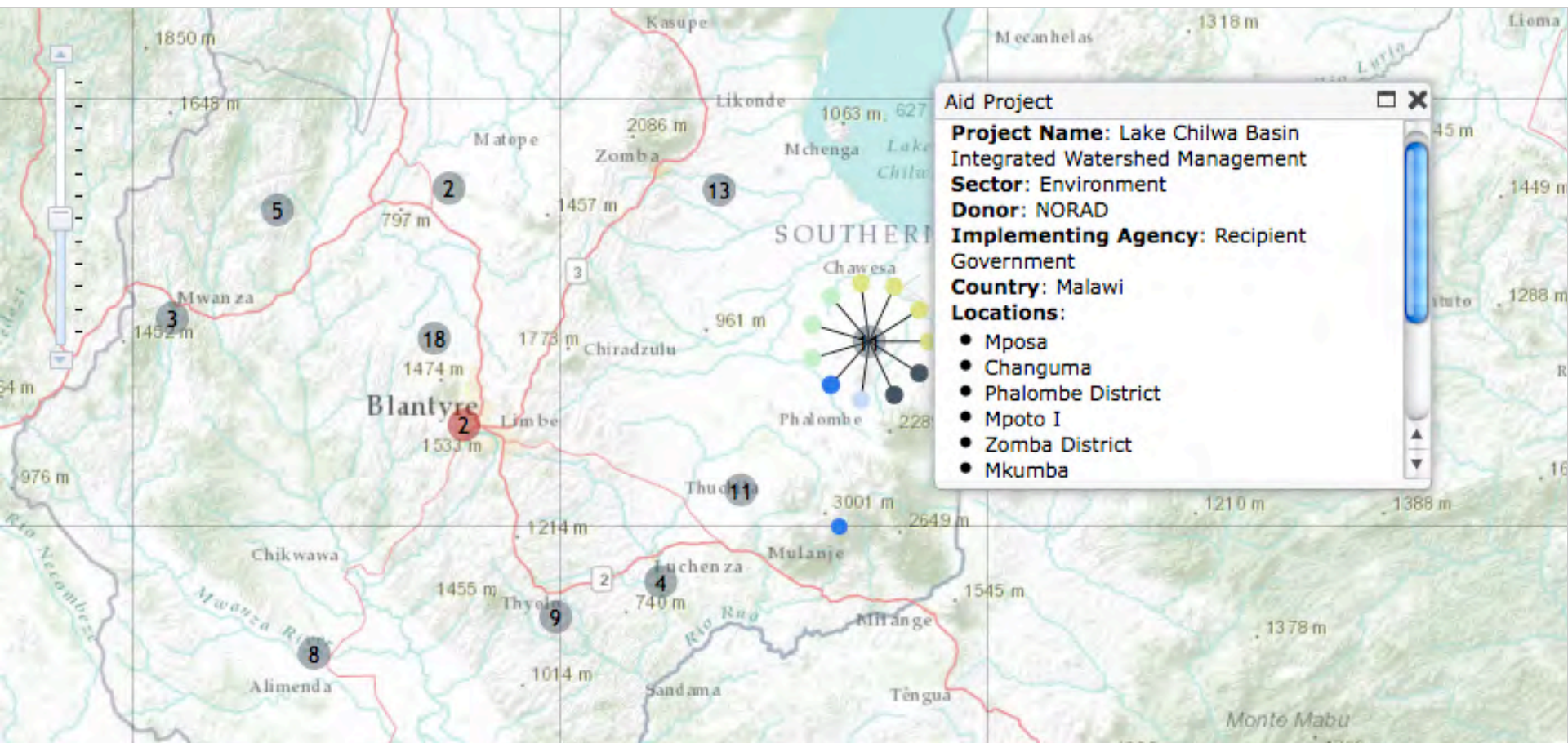
Users can then assess how aid projects relate to areas of climate security vulnerability



C. Weaver, N. Krishnan, M. Findley, J. Baker, C. Peratsakis (aid data);
J. Busby, T. Smith, N. Krishnan (vulnerability data)

How is aid allocated by region, sector, and demographics in a country?

Seeing how aid project locations align with income, health, and livelihood distributions informs aid assessment, planning and coordination.



CCAPS AID DASHBOARD

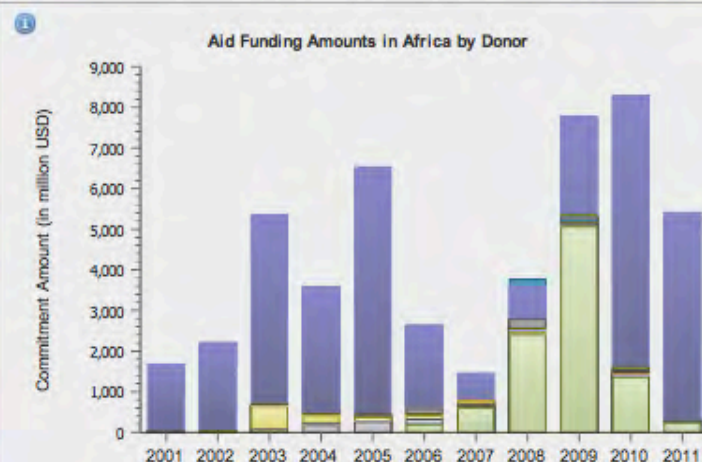
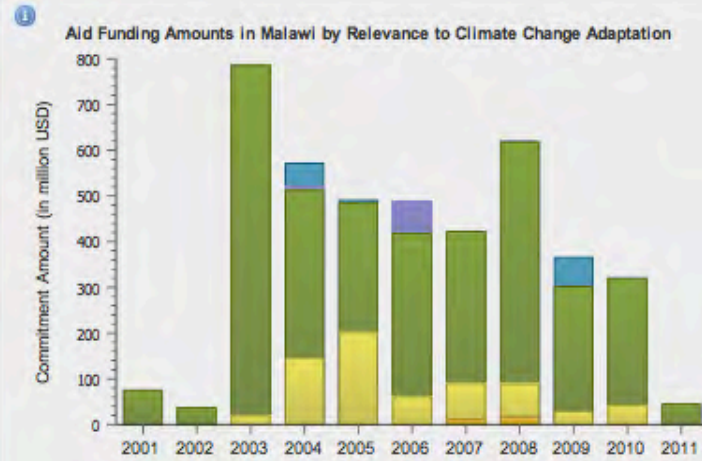
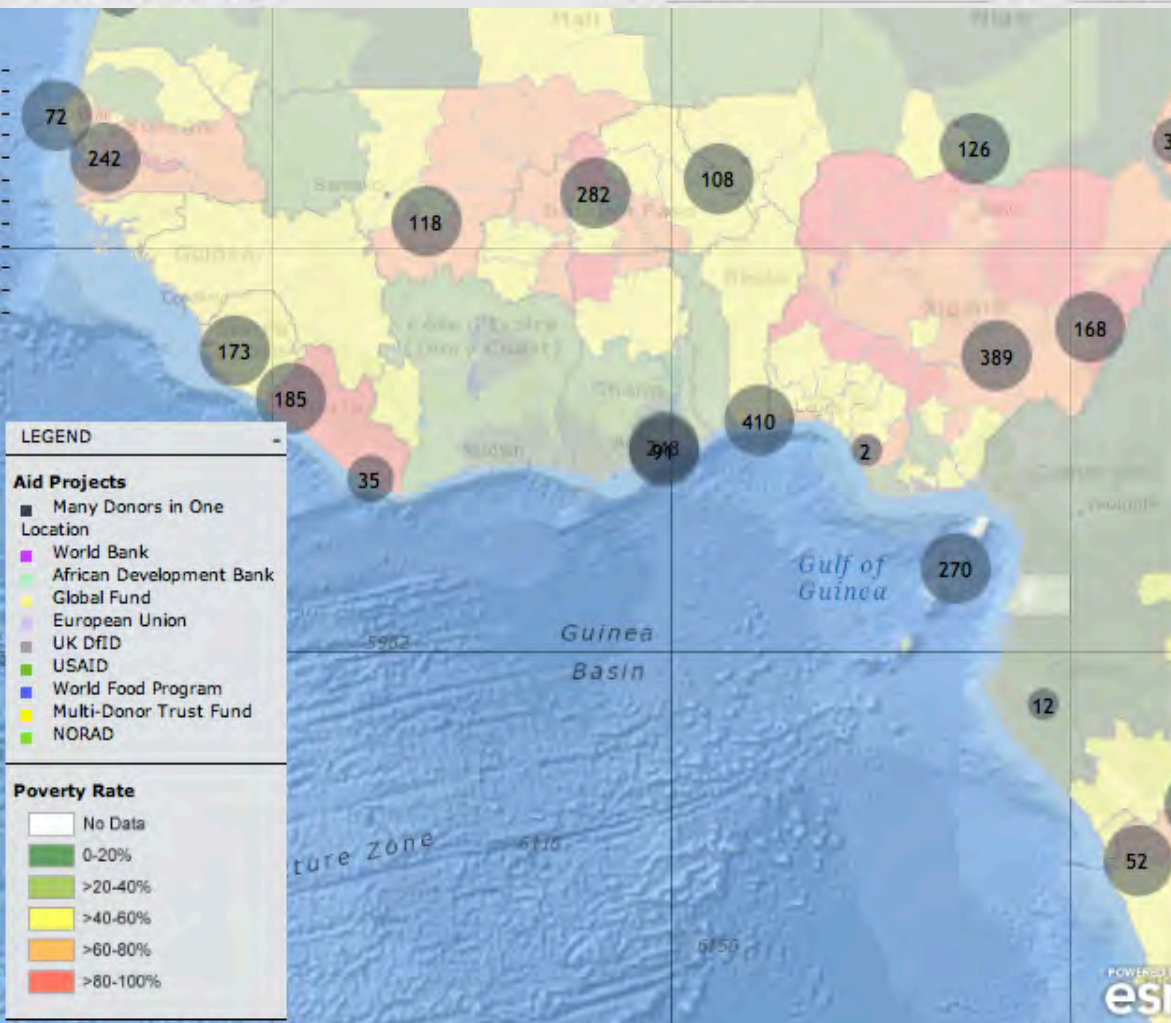
Country: All selected

Layers: 2 selected

Basemaps

Advanced Filters

Download Data



DASHBOARDS: CCAPS aid dashboard allows us to explore aid spending as big-picture trends or individual project information

CLIMATE CHANGE
AND AFRICAN
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CCAPS CONFLICT DASHBOARD

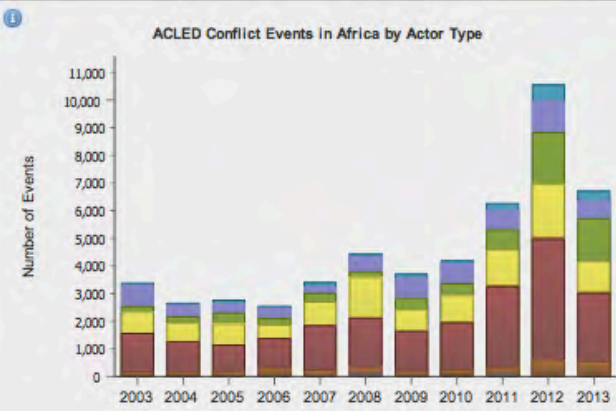
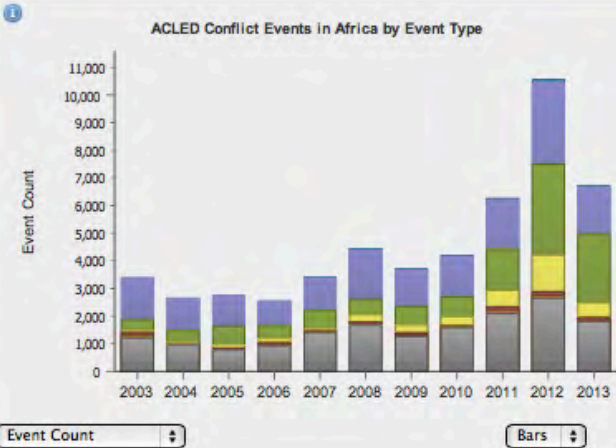
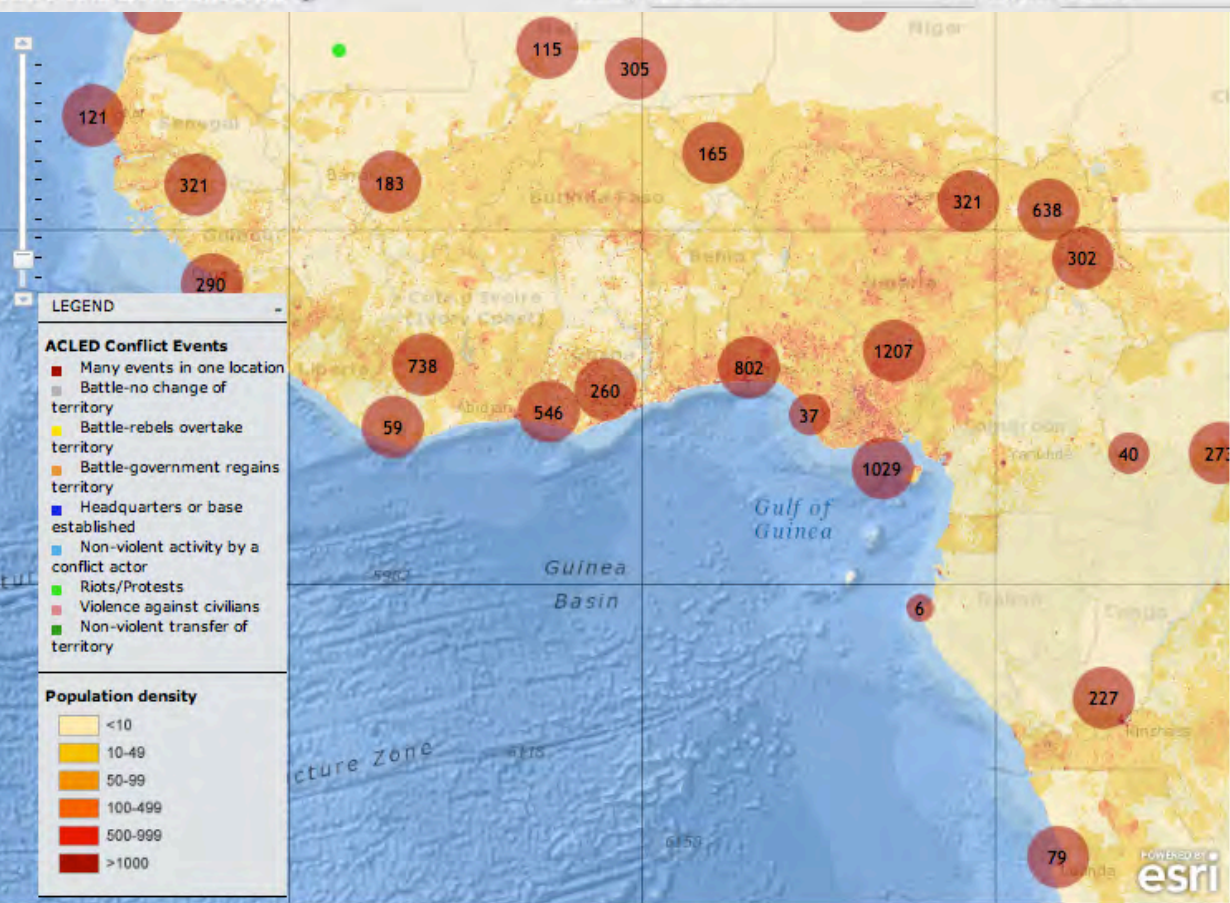
Country: All selected

Layers: 2 selected

Basemaps

Advanced Filters

Download Data



Event Id	Country	Location	Event Date	Event Type	Actor 1	Actor 2	Deaths
6875RTA	Egypt	Aswan	2013	Riots/Protests	Protesters (Egypt)		0
6884RTA	Egypt	Monofeya	2013	Riots/Protests	Protesters (Egypt)		0
6862RTA	Somalia	Baraawe	2013	Battle-no change of territory	Al Shabaab	Al Shabaab, Militia (Ahmed Godane)	5
6864RTA	Somalia	Marka	2013	Battle-no change of territory	AMISOM: African Union Mission in Somalia (2007-)	Unidentified Armed Group (Somalia)	0

DASHBOARDS: CCAPS conflict dashboard is updated monthly



BUILDING THE CLIMATE SECURITY VULNERABILITY MODEL

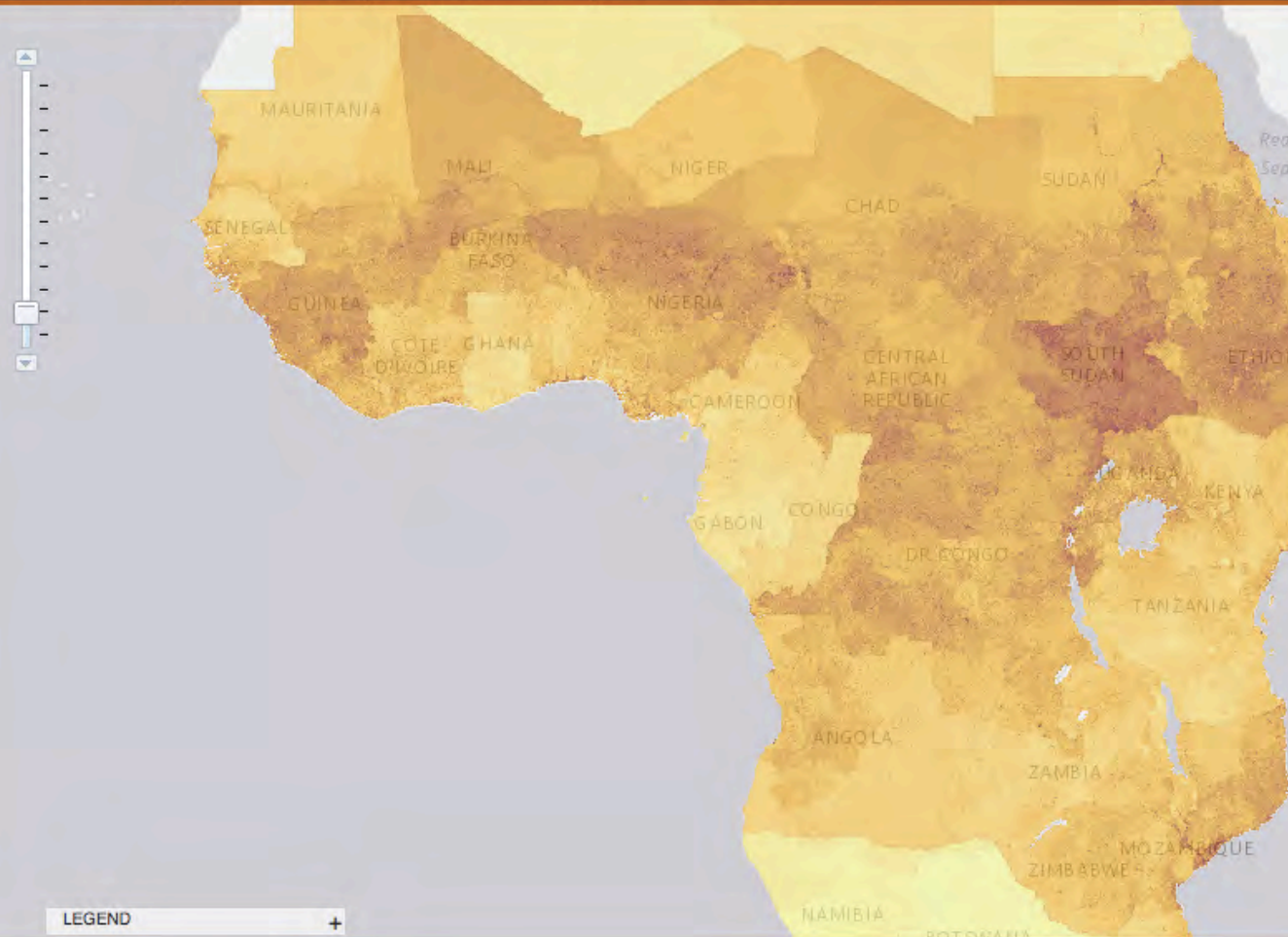
Overview Hazards Population Households Governance Final Composite Resources

Model Design

The CCAPS Climate Security Vulnerability Model aims to identify subnational locations of "climate security" vulnerability in Africa. Going beyond mere livelihoods-based analyses of vulnerability, this mapping project has a specific security focus, identifying the places where the worst consequences of climate change are likely to hit and put large numbers of people at risk of death. The CCAPS model goes beyond national-level vulnerability rankings to identify vulnerabilities at the local level.

The CCAPS model starts with four baskets or processes—physical exposure to climate related hazards, population density, household and community resilience, and governance and political violence—that capture the salient sources of vulnerability. These sources of vulnerability are described as "baskets" since they contain multiple indicators. Within three of the four baskets, several indicators are included that contribute to that dimension of vulnerability. Subnational data with fine-grained resolution are used wherever possible.

The CCAPS model weights each basket equally and creates a composite index by adding the four baskets together.



DASHBOARDS: CCAPS climate vulnerability dashboard explores how various factors influence overall climate security vulnerability at the local level



CLIMATE CHANGE AND AFRICAN POLITICAL STABILITY

PROJECT INFORMATION

Project ID: **Kariba Dam Hydro-electric power plant Phase 2**

Recipient: **Recipient 1**

Purpose Name: **Purpose Name 1**

Donor: **DFID**

Year: **2012**

ACTIVITY SPECTRUM SCORE ASSESSMENT

Activity Name	Pre-set Spectrum Score	Adjusted Spectrum Score	Comments
Food Crop Production	Capacity Development	Adjust Activity Spectrum Score ▼	
Community Participation and Development	General Development	Capacity Development ▼	

OVERALL PROJECT ASSESSMENT

Climate Reference Indicators

Marker	Value
Project Phase/Component ⓘ	<input type="checkbox"/> Pilot Project <input type="checkbox"/> Capacity building and training <input type="checkbox"/> Additional financing to existing project <input type="checkbox"/> Technology development/deployment <input type="checkbox"/> (Feasibility) study/planning <input type="checkbox"/> Has research component
OECD Rio (Mitigation) Marker ⓘ	Not Targeted ▼
OECD Adaptation Marker ⓘ	Not Targeted ▼
Climate Reference ⓘ	<input type="checkbox"/> Specifically lists climate change as theme/portfolio/sector/objective <input type="checkbox"/> "Climate (change)" appears in text [in reference to climate change] <input type="checkbox"/> NAPA/NAMA referenced <input type="checkbox"/> Has climate (vulnerability) assessment <input type="checkbox"/> "Adaptation" appears in text [in reference to climate change] <input type="checkbox"/> Other "adaptive/climate strategy" appears in text [in reference to climate change] <input type="checkbox"/> Has environmental (vulnerability) assessment <input type="checkbox"/> "Adaptation" appears in text [in reference to climate change]
Climate Relevance or Risk Response ⓘ	<input type="checkbox"/> N/A <input type="checkbox"/> Mitigation <input type="checkbox"/> Precautionary Adaptation <input type="checkbox"/> Reactionary Adaptation

SUSTAINABILITY: Open source climate and geocoding interface provides platform for donors and recipients to track climate aid themselves



More Information

- Data: [**www.strausscenter.org/ccaps/data**](http://www.strausscenter.org/ccaps/data)
- Mapping: [**www.strausscenter.org/ccaps/mappingtool**](http://www.strausscenter.org/ccaps/mappingtool)
- Publications: [**www.strausscenter.org/ccaps/publications**](http://www.strausscenter.org/ccaps/publications)
- Course modules: [**www.strausscenter.org/ccaps/publications**](http://www.strausscenter.org/ccaps/publications)

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